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CANADA

DEPARTMENT OF THE INTERIOR

Hon. Charles Stewart, Minister W. W. Cory, Deputy Minister

Topographical Survey: F. H. Peters, Director

ANNUAL REPORT

OF THE

TOPOGRAPHICAL SURVEY

FOR THE

FISCAL YEAR ENDING MARCH 31, 1925

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MAPS

Reduced copy of Reindeer Lake map, to illustrate detailed information obtained from aerial surveys.

Township development plan, land classification surveys.

Western Canada, showing monumented surveys.

Western Canada, showing areas mapped.

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REPORT

OF THE

TOPOGRAPHICAL SURVEY, DEPARTMENT OF THE INTERIOR

The various classes of work described in the previous annual report were continued, but by twenty-nine parties as compared with thirty-eight in the previous year. The appropriation was $470,000 as compared with $520,000 for 1923-24.

The outstanding feature of the year was the increase in the area covered by aerial surveys. In the two previous fiscal years the application of aerial photography to mapping was limited to small areas mostly for experimental purposes. Not only were plotting methods perfected but great economies in operation were brought about by an arrangement whereby the Topographical Survey became a central bureau or agency for all federal services in the matter of civil aerial photography. The actual photographic operations were carried out by the Royal Canadian Air Force under technical instructions drafted by the Survey. In this way a single flight could often be made to serve the forester, the geologist, and the water power engineer, as well as the surveyor. All photographs were indexed and filed by the Topographical Survey where they are readily available for future as well as present requirements.

Requests for maps to assist prospectors, foresters, and others interested in the development of our country and of its natural resources continue to increase. With the introduction of the aerial maps showing so completely all interesting features of a district, so great has been the public demand that large issues have had to be printed and the stock of several was completely exhausted within a few months of their issue. The revenue from the sale of maps and plans is mounting steadily. In addition the many free copies distributed to federal and provincial officials mean a great saving to them in surveys and special field investigations.

During the year approximately 32,000 maps, 13,000 plans, and 1,400 reports were distributed.

RESUME OF OPERATIONS FOR THE YEAR

Topographical and photo-topographical surveys.—Surveys for the purpose of preparing a series of basic maps showing detailed topographic information, and for use in agricultural, water power, mining, and forestry development; Dominion parks, forestry, municipal, and property administration; the location of highways and railways; and for other purposes.

The year's work covered 15,910 square miles, distributed as follows:—

	Square miles
Nova Scotia	550
New Brunswick	230
Quebec	580
Saskatchewan	8,500
Alberta	5,400
British Columbia	650

Aerial surveys.—Preparation of the technical instructions for all photographic surveys made for the federal services; indexing and filing copies of all aerial photographs; preparing mosaics of vertical-axis photographs; plotting topography and compiling maps from oblique-axis views.

The photographic surveys during the past fiscal year were for mapping and map revision, forest protection and development, mapping of timber types,

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the investigation and development of the mineralized and forested areas of northern Canada, land classification and soil surveys, defining limits of forest reserves, town planning, road construction, water storage, development of tourist traffic, and for administrative and illustrative purposes.

The year's work covered 40,570 square miles, distributed as follows:—

	Square miles
Nova Scotia	2,892
Eastern Ontario	62
Western Ontario and Eastern Manitoba	10,936
Northern Manitoba and Saskatchewan	17,350
Alberta	9,300
British Columbia	30

Land classification surveys.—Examination of vacant quarter-sections for future settlement; soil surveys; examination of forest reserves for adjustment of boundaries.

The year's work covered 3,536,000 acres, distributed as follows:—

	Acres
Manitoba	123,648
Saskatchewan	1,560,000
Alberta	1,852,352

Control and exploratory traverse surveys.—Traverses of northern waterways for navigation purposes, for control of settlement lots and mining claims, and for geological and forestry mapping; explorations; control for plane table topographical surveys.

Shore line traversed:—

	Miles
Manitoba	3,361
Saskatchewan	1,605
Northwest Territories	1,939
Total	6,905

(The work in the Northwest Territories also included 120 miles of chain traverse and 450 miles of exploratory traverse.)

Control for plane table topographical surveys:—

	Miles
Quebec—chain traverse	225
stadia traverse and levels	320
Nova Scotia—chain traverse	229
stadia traverse and levels	312
Total	1,086

Land surveys.—Re-establishment of lost corners, township subdivision and surveys of dried-up lake beds, town and settlement lots, summer resorts, Dominion parks, and forest reserves. During the year 56 localities were visited by surveyors on this work.

Many matters of a legal nature are dealt with by the Land Surveys division. Instructions are prepared and the returns of survey of mineral claims examined and approved. Where Dominion lands are affected plans of railways, roads, irrigation and drainage canals, transmission lines, power sites, and flooded areas are examined and approved or confirmed by the Surveyor General of Canada as required by law. In many cases special instructions for surveys must be prepared even though the surveys are made by surveyors not employed by the Topographical Survey. A vast amount of technical correspondence with various federal and provincial departments, municipal officials, surveyors, legal firms, and the public is dealt with involving such matters as reports on water areas, accrued lands, legal descriptions of parcels of land, interpretation of information on plans, etc. Areas of 23,000 parcels of land in 350 townships were computed during the year in response to departmental and municipal requests.

Levelling.—Secondary control levels for topographic maps, engineering profiles, water power, reclamation and irrigation projects, location of railways and roads, etc., also tertiary levels in connection with subdivision surveys and topographic mapping.

The year's work comprised 1,162 miles distributed as follows:—

	Miles
Nova Scotia	228
Quebec	240
Saskatchewan (including ties)	203
Alberta (including ties)	491

Interprovincial boundary surveys.—The survey was completed of that portion of the Alberta-British Columbia boundary which it is intended to mark on the ground at present.

The season's work comprised approximately 100 miles.

Other work.—In addition to the above and to the regular work of administration and examination of accounts, the other activities which will be dealt with hereunder are included under the headings of Magnetic Surveys, Physical Testing Laboratory, Mechanical Division, Registration, Records and Distribution, Geographic Board, Board of Examiners for Dominion Land Surveyors, and Board of Topographical Surveys and Maps.

TOPOGRAPHICAL AND PHOTO-TOPOGRAPHICAL SURVEYS

During the season of 1924 complete topographical information was obtained for the revision of three sheets of the Sectional Map of Canada, namely, Weyburn, No. 20, by J. Hardouin, D.L.S.,; Yorkton, No. 170, by G. C. Cowper, D.L.S.; and Sullivan Lake, No. 216, by W. A. Fletcher, D.L.S. Vermilion, No. 316, which was partly surveyed last year, was completed by R. H. Knight, D.L.S. Altogether complete topographical information has now been obtained on 31 sheets covering an area of about 133,000 square miles. The usual contour interval is fifty feet.

Altogether 133 sheets of the Sectional Map of Canada have been printed, of which 21 are the modern revised series showing detailed topographical information including buildings, roads, telephone and telegraph lines, etc. These sheets are printed in seven or eight colours. Ten other sheets are printed in five colours and show approximate contours. The remainder are printed in one or two colours and do not show contours. The scale of the Sectional Map of Canada is one inch to three miles. The sheets are 24 by 34 inches and each covers 120 townships or an area about 50 by 90 miles.

On the Vermilion sheet the topographical information was obtained in conjunction with the examination of the country for land classification purposes. Vertical aerial photographs taken by the Royal Canadian Air Force were a large factor in the success of the work. It is estimated that by the use of photographs on work of this nature, the area covered in a season is increased approximately one hundred per cent.

At the request of the Edmonton Board of Trade and the Canadian Institute of Mining and Metallurgy, a complete topographical survey of an area in the immediate vicinity of Edmonton was made, the field work being carried on by W. H. Norrish, D.L.S. The resultant map will be published shortly on the scale of one inch to one mile with a contour interval of twenty-five feet. Vertical aerial photographs also played a considerable part in the success of this undertaking. Photographic copies on carbon matte and blue-print paper of mosaics made from aerial photographs were used in the field as plane table sheets. These greatly increased the speed of the work, as much detail was shown in correct horizontal position. The topographer's work was reduced to interpreting the prints and locating the contours.

CENTRAL EXPERIMENTAL FARM, OTTAWA, ONT.

The most modern practice in topographical mapping includes contouring by plane-table methods on individual photographs or groups of photographs assembled as mosaics.

M. P. Bridgland, D.L.S., was engaged in the survey of part of the Rocky Mountains forest reserve at the headwaters of North Saskatchewan river. This survey was carried out by the photo-topographical method, which is so well suited to mountainous country. The work done is of sufficient accuracy to allow publication on the scale of one inch to one mile.

In British Columbia, C. H. Taggart, D.L.S., was engaged in a topographical survey of a one inch to one mile sheet of the Topographic Map of Canada in the vicinity of Kamloops. This sheet lies between latitudes 50° 30′ and 50° 45′ and longitudes 120° 00′ and 120° ~~15~~ 30′ The contour interval is one hundred feet. Considerable progress was also made in the survey of a one-half inch to one mile sheet of the same series lying between latitudes 50° 30′ and 51° 00′ and longitudes 120° 00′ and 121° 00′. In carrying out the survey of these sheets the photo-topographical survey methods were adopted for the mountainous parts, while in the valleys the topography was mapped mainly by use of the rangefinder and transit. For control a system of triangulation was expanded from two bases, surveyed along the Canadian National railways and connected with points established by the Geodetic Survey of Canada; stadia traverses were also run along all roads. Next season it is hoped to connect this system with the triangulation of the Railway Belt of British Columbia between the Kootenay and Salmon Arm bases.

In Quebec, C. Rinfret, D.L.S., completed the topographical survey of the Warwick sheet which lies between latitudes 45° 45′ and 46° 00′ and longitudes 71° 30′ and 72° 00′. The published scale of this map will be one inch to one mile and the contour interval twenty-five feet. This work was carried on in co-operation with the Department of National Defence.

In New Brunswick, B. W. Waugh, D.L.S., was engaged in the mapping of the Sussex sheet for publication on the scale of one inch to one mile. This sheet occupies an area in general a few miles northeast of Saint John. Its boundaries are latitudes 45° 30′ and 45° 45′ and longitudes 65° 30′ and 66° 00′. The contour interval of the published map will be twenty-five feet.

In Nova Scotia, P. E. Palmer, D.L.S., commenced the topographical survey of the New Glasgow one inch to one mile sheet, bounded by latitudes 45° 30′ and 45° 45′ and longitudes 62° 30′ and 63° 00′. The contour interval of this sheet is also twenty-five feet.

Instructions for all topographical work were prepared in the Topographical Division and all necessary information regarding the areas to be surveyed was provided for the use of the surveyors.

Map of Kootenay park.—This map was mentioned in the previous annual report. The compilation was completed some time ago but publication has been delayed pending agreement between the Dominion and Provincial authorities on the final location of the park boundary.

Map of Banff and vicinity.—A reprint of this map was undertaken at the request of the Commissioner of Canadian National Parks. The scale is one inch to one mile and the contour interval is 100 feet. Complete information has been handed over to the mechanical division for the production of this map.

Lake Louise sheet.—This map also was undertaken at the request of the Commissioner of Canadian National Parks. It is bounded by latitudes 51° 15′ and 51° 30′ and longitudes 116° 00′ and 116° 30′. The contour interval is 100 feet and it is expected that the map on the scale of one inch to one mile will be published at an early date.

Wainwright Park map.—This park is near Wainwright, Alberta, and is included in townships 42 to 45, ranges 6 to 9, west of the Fourth meridian. The scale of publication of the map is one inch to one mile, and the contour interval is fifty feet. Considerable aid in the compilation of this map was derived from the use of aerial photographs taken by the Royal Canadian Air Force.

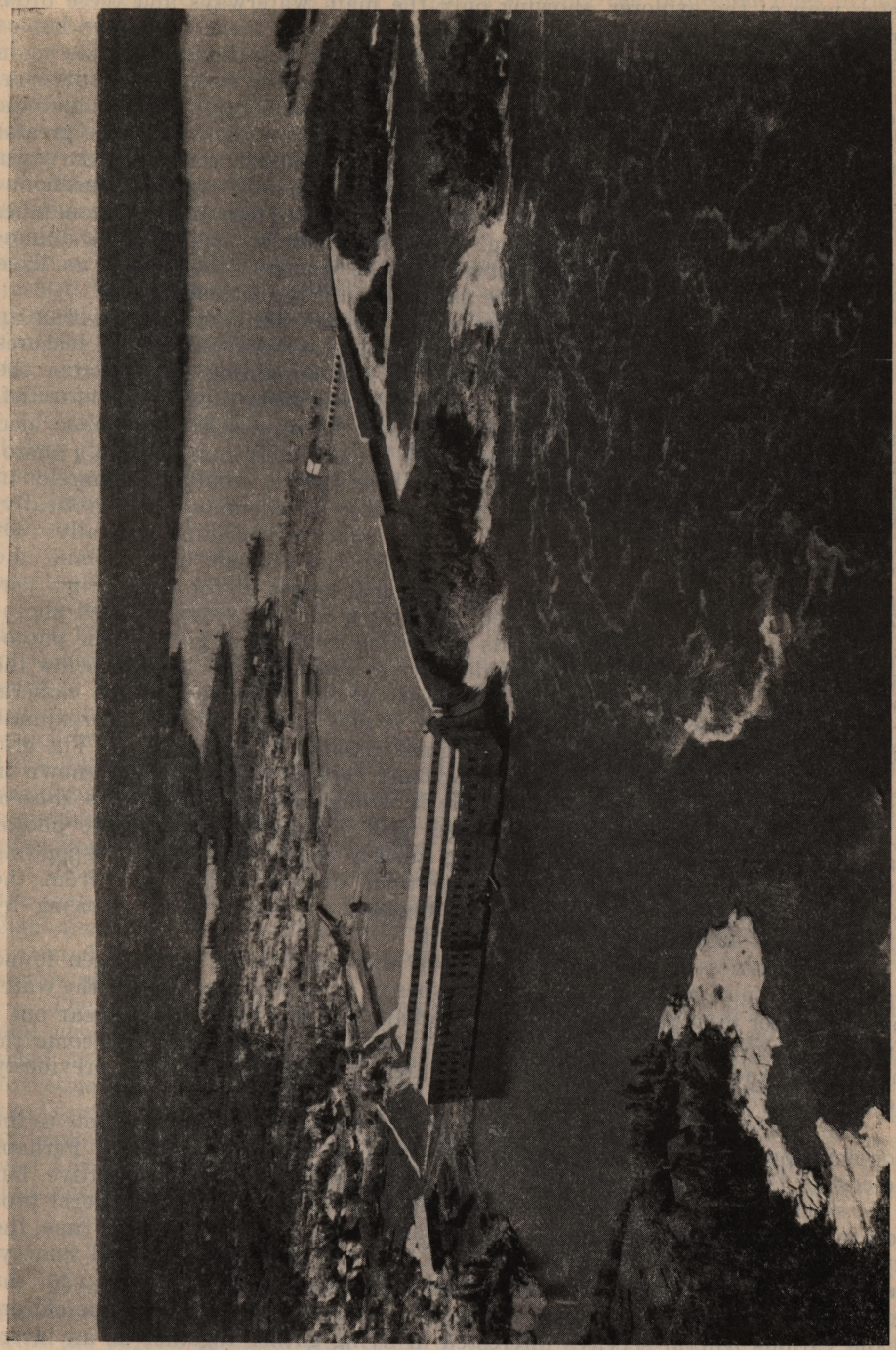
AERIAL SURVEYS

The aerial surveys conducted in the years 1922-23 and 1923-24 were mostly of an experimental nature. Those of the former year were carried out solely for the purpose of determining the feasibility of utilizing aerial photography in conjunction with ground surveys in the economic compilation of maps, more especially maps of the comparatively inaccessible areas of northern Canada. These areas gave promise of furnishing a favourable field for economic mapping by means of oblique aerial photography, since the control traverses can be utilized for fixing the air positions of the camera lens in plotting topographical details, such as the shorelines of lakes, from the photographs. These operations were not extensive and the areas chosen for photography were such that the photographs could be taken on the regular forest patrol flights of the Royal Canadian Air Force, undertaken for the Dominion Forest Service. The cost of these operations was therefore practically limited to the cost of the photographic materials.

There seemed to be a large field of usefulness for aerial photography in Canada, particularly in the mapping of the lakes and rivers of the mineralized and forested areas of the north where the ground surveyor was handicapped by a short season and must limit his work to traverses of the main travelled waterways. On account of transport difficulties and for economic reasons it was not practicable for him to venture inland and his information was therefore necessarily very incomplete. The same difficulties beset the experts on forestry, geology, water powers, etc.

The experimental work proved the feasibility of mapping the main topographical features such as lakes and rivers of the practically unknown northland from oblique aerial photographs used in conjunction with a ground control survey. The cost of flying was a paramount consideration and the first point to be noted is that an oblique photograph or one taken with the camera pointed over the side of the aircraft and depressed below the horizon covers a very much greater area than one taken with the camera pointing vertically downwards through the fuselage.

The vertical photograph at once provides a plan of the ground to a definite scale; and, provided the plane is flown at a uniform altitude and the camera kept truly vertical, the consecutive exposures may not only be joined together into a " strip " mosaic, but the exposures to either side taken on adjoining lines of flight may be joined on, thus making a " sheet " mosaic. This is the type of aerial photography suited to the larger scale photographic mapping where considerable detail is to be shown. The mosaic or " air plans " may be furnished to the surveyor working on the ground and the map completed by surveying and drawing the contours across the mosaic and identifying and inking in the necessary details to complete the topographic map. The method is particularly applicable to more or less settled country of moderate relief. If the relief of the country were great—in other words hilly—the scale of adjoining photographs would not be uniform and they could not be joined into mosaic. Each individual exposure could still be used by the surveyor to very great advantage in filling in details on his map, for the roads, railroads, buildings, and cultivated, pasture, and wooded areas are shown, and even the minutest streams or watercourses which might pass unnoticed on the ground are clearly distinguishable in a vertical air photograph. Vertical photography therefore gives the greatest amount of detail but requires many more exposures and a much greater amount of flying to cover a given area.



POINTE DU BOIS POWER STATION

Aerial view for power development purposes on Winnipeg river.

To return therefore to the interesting field of development of the natural resources of Canada's little-known northland, the problem was to replace the sketch map of the explorer, showing only the main waterways and these often very inaccurately, with accurate maps not only of the travelled routes but of the country inland. The ground surveyor's vision was limited to the main waterway he was following; the aerial camera became the eyes of the surveyor, another instrument which not only recorded the innumerable islands and the intricacies of shore line of the stream or lake he was following with greater detail than was possible for him, but it reached far inland, giving his survey a breadth otherwise impossible except at prohibitive cost. Of course for economic reasons it was desired to use oblique photography, thus minimizing the number of exposures and the amount of flying. The ground survey could not be eliminated because there were no land surveys in the country; there were no fixed points from which the position of the camera could be determined.

Now the ground survey and the aerial survey are working together in harmony. The function of the ground survey is to fix certain well defined features in correct position to enable the plotting of the remaining details from the photographs. The country in which the method has been used is of low relief, practically a plane surface. If this surface may be supposed to be subdivided into half-mile square plots, the dividing lines being clearly marked out, a photograph of it would be a perspective view and these squares would grow smaller in the distance. Reversing the process it is possible to calculate mathematically, and accurately draw a perspective of a set of squares vanishing centrally. Of course it is necessary to take into consideration the altitude of the plane, the degree of depression of the camera, and the focal length of the lens. Such perspectives or "grids," as they are called, are drawn to large scale, reduced photographically and positive working grids printed on celluloid or glass. The photographs show the horizon line, and the distance of this apparent horizon below the upper margin of the photograph is a measure of the depression of the camera. From the large stock of grids on hand one is now chosen for the approximate altitude of the plane and the correct marginal distance to the horizon. The grid is placed on the photograph and if the ground control points are not shown in correct relationship the assumed altitude is wrong and another grid is chosen. In two or at most three trials the correct grid is superimposed on the photograph; and the lakes and rivers are then quickly drawn into the corresponding squares on cross section paper. The portions drawn in this way from the individual photographs are then joined together on the working drawing by utilizing the ground control points in fitting.

The usefulness of the photograph does not stop here as it has been found practicable to plot therefrom the timber types or again the geologist or the water power engineer may be interested in it; perhaps not this year or next year but a generation hence a development project is actually planned and out come the photographs and the grids ready to immediately plot some feature not previously thought to be of importance.

The varied usefulness of aerial photographs was seen to be the keynote to the economic application of aerial photography in the government services. Perhaps the cost of the operation required for one department would be prohibitive, but if the same photographs would serve another federal service; or, if several projects in the same district could be grouped and undertaken at the same time, the expenditure would be fully justified. To this end the Topographical Survey, Department of the Interior, has been created a central agency or bureau for the development of aerial surveying. Each year before the flying season the officers of the various federal services interested in flying gather together as an interdepartmental committee with officers of the Royal Canadian Air Force and the year's requirements are carefully considered and co-ordinated.

The Topographical Survey then prepares the technical instructions. During the last fiscal year detailed instructions to accompany fifty-one operation orders were written. Guide maps were prepared showing the projected lines of flight and the portions most suitable for morning or afternoon photography. Where the existing maps are wholly unreliable or none available a Dominion land surveyor skilled in exploration and mapping from both ground and aerial surveys accompanies the crew of the aircraft as navigator. This also permits of the alteration of the instructions to meet unforeseen conditions, and the arrangement ensures the maximum efficiency of the operation.

Twenty-three aerial photographic operations were carried out in the 1924 field season; fifteen were of the oblique axis type, seven were vertical and on one operation both types of photography were used. The discrepancy between the number of operations for which instructions were written and the number performed is accounted for mainly by the fact that a number of operation orders, particularly covering photography to illustrate power plants in Ontario and Quebec, expressly stipulated that the work was not to be undertaken unless favourable opportunities were presented for securing the photographs in connection with more important operations.

Altogether 40,570 square miles were photographed, 37,018 square miles being oblique and 3,552 square miles vertical axis photography. The purposes included mapping and map revision, forest protection and development, mapping of timber types, the investigation and development of the mineralized and forested areas of northern Canada, land classification and soil surveys, defining limits of forest reserves, town planning, road construction, water storage, development of tourist traffic and administrative and illustrative purposes.

The Topographical Survey files a copy of each photograph taken by the Royal Canadian Air Force. A graphical index shows the area covered by each photograph. In years to come, when the collection grows, it will be possible not only to supply the public with the compiled maps covering any district but a person may ask for and secure photographs showing the intimate details with which he is concerned and which are not shown on the maps. Considering how little publicity has been given aerial surveys it is remarkable how many requests are already being dealt with for aerial photographs. These come from provincial government officials, city engineers, mining and lumbering corporations, professors of geology and mineralogy, and officers of municipalities.

The value of the maps is emphasized by the fact that the entire edition of the map of The Pas mineral area published in August, 1924, was exhausted in eight months. As a result of last season's flying the revised edition, now being prepared, will show detailed topographical information over an additional 5,500 square miles.

The system of plotting now used permits of rapid compilation. The ground and aerial surveys of the Reindeer lake district in 1924 have already been compiled into a map covering 9,039 square miles, to serve as a basis for geological investigations and forestry protection and development. Preliminary editions of the Oiseau sheet, No. 124, and the Cross Lake sheet, No. 74, of the Sectional Map of Canada compiled from 1924 aerial and ground surveys will shortly be issued; and it is hoped to issue the standard one inch to one mile topographic map of the Edmonton district in about a year from the commencement of flying operations.

LAND CLASSIFICATION SURVEYS

During the course of the period under review, land classification and reconnaissance surveys were continued within selected areas in the western provinces, with the objects of classifying lands of agricultural possibilities and of recommending other lands to be reserved to better advantage either for grazing or forestry purposes. Lands included in the first category were systematically

classified and graded, taking into account such important factors as the nature of their surface, surface covering, their accessibility, soil contents, and all other matters directly affecting their successful development as farm units. The objective sought in this work is to bring the unoccupied lands into productive use so as to benefit not only the immediate district but the country as a whole. The other work was within or adjacent to existing or proposed forest reserves in order to determine the boundaries which should be adopted between Dominion lands and forest reserves.

During the past field season, three parties were wholly engaged on land examination and classification surveys, while two others were similarly employed from the outset of the season to the middle of July, after which they were transferred to other activities. The combined examination for the season covered 3,536,000 acres of which 593,088 acres were within forest reserves. The total area which has been examined now comprises 28,000,000 acres, including a little over 3,500,000 acres within forest reserves. In addition, a cursory examination has been made of several large districts to determine whether further investigation is necessary.

During the past year, J. W. Pierce, D.L.S., investigated portions of Duck Mountain and Riding Mountain forest reserves in Manitoba having an area of 123,648 acres. Two parties operated in Saskatchewan; one under M. D. McCloskey, D.L.S., examined 469,440 acres in portions of Porcupine and Pasquia Hills forest reserves, and the other under S. D. Fawcett, D.L.S., classified 1,090,560 acres in the district north and east of Onion lake. In Alberta, R. H. Knight, D.L.S., classified an area of 1,658,880 acres in 72 townships in the Vegreville and Vermilion district, and W. Christie, D.L.S., examined an area of 193,472 acres in townships 51 and 52, ranges 14 to 20, west of the Fifth meridian.

In connection with the detailed field examination required on land classification surveys and with the view of affording a practical test of the value to be derived from vertical aerial photographs as an aid to our field operations, the Royal Canadian Air Force supplied aerial views during the season for the area covering seventy-two townships situated in the Vegreville and Vermilion districts, where R. H. Knight, D.L.S., was working. Having the aid of these views, he combined a topographical survey with his classification surveys. This party was engaged in field operations for a period of five months. The value of aerial photographs on such work is conclusively shown by the larger area that can be covered during a field season. Similarly topography comprising cultivated areas, bluffs, sloughs, creeks, and similar features when taken from the air is more accurate and reliable than that obtained by the prevailing method of sketching.

The field officers on their return to the office at the close of the field season devote their attention to the preparation of their final returns which consist of compiled plans and maps, and township and other reports which are prepared both for the use of other services and the public.

Four sets of maps, each consisting of a land classification and a soil map, have been compiled and issued to cover the Turtleford district and the district north and east of Preeceville, in the province of Saskatchewan, and the district east of Vegreville and the Sylvan lake district in the province of Alberta.

The two maps for each set are printed on a scale of one inch to three miles, and besides showing the main topographical features in the respective districts, distinguishing colours are employed to show in one case the unoccupied quarter-sections according to their suitability for agriculture, while the complementary or soil map shows the main soil types of the area.

A map on a scale of one inch to four miles was also published for the Peace River block, province of British Columbia, with distinctive colour characteris-

tics showing the classification of the surface covering of the lands and the main topographical features within the borders of the said block.

Other published information consists of standard portfolios of township development plans and bound typed reports for each district examined. Twelve of the former and six of the latter have been supplied to Dominion Land Agencies and Sub-agencies, where they are held at the disposal of intending settlers or other parties for consultation. To meet special requests from the Colonization and Development Departments of the Canadian Pacific and Canadian National Railways, the Deputy Minister of Agriculture for the province of Alberta, and other provincial officials, eight additional portfolios and the same number of district reports for surveys made during the season of 1923 were prepared and supplied as requested.

The edition of the manual of instructions for the investigation of soils issued in 1919 for the guidance of our field officers being out of print, the occasion was considered favourable for its revision and at the same time it was decided to enlarge its scope along lines adopted and in use by other public and private services interested in soil investigations. This revision, including the proposed amendments, has progressed satisfactorily and it is expected to have the new edition ready for the use of the surveyors during the coming year.

In the past it has been the practice to colour by hand a few copies of each township plan showing land classification. These few copies were supplied to the Agents of Dominion lands at the agencies particularly interested in the lands. As these plans became known to other officials and to interested individuals a demand arose for additional copies which could not be economically met by the method of hand colouring. It was therefore decided to publish by the photo-lithographic process a small edition of a few plans as an experiment. The usefulness of these plans was also increased by printing on the back of each a report on the township giving as much information as possible about the land, soil, surface cover, municipal and private improvements, roads, water supply, topography, etc. Township development plans, as they are called, have been issued in this way for townships 49 to 53, ranges 7 to 14, west of the Fourth meridian.

Soil laboratory.—The laboratory for testing and analysing the samples of soil collected by land classification surveyors is located in Saskatoon where accommodation is provided in the University of Saskatchewan. During the year 208 samples of soil were given physical analysis. Ten of these were tested and analysed for the Forestry Branch of the Department.

Physical analysis gives the percentages of fine gravel, coarse sand, medium sand, fine sand, very fine sand, silt, and clay. The samples are also tested for alkalinity, acidity, organic matter content, and hygroscopic moisture. The record kept for each sample includes information on the character of the natural vegetation. Reports are prepared for all samples tested and are used in grading lands according to their suitability for settlement.

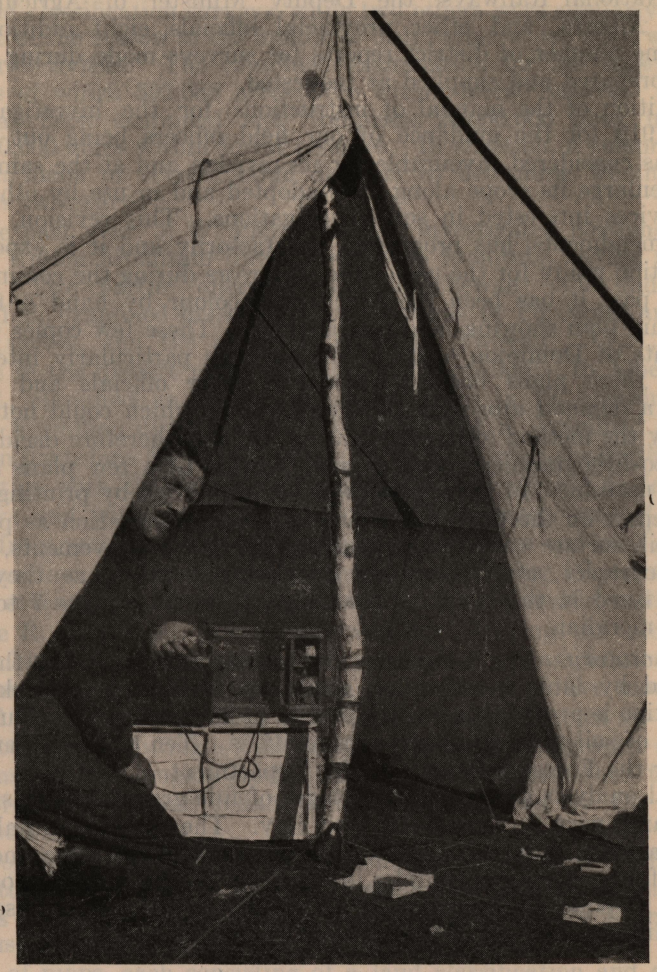
CONTROL SURVEYS

The control survey method was devised to meet the situation existing in Canada of more or less intensively surveyed country in the south adjoining the almost unknown northland. The methods by which the agricultural lands of the south were subdivided into areas of uniform size, regularly distributed, are not suitable for the north where the usefulness and desirability of the land varies greatly and the cost of opening up lines and transporting men and materials becomes increasingly high.

The situation called for a method of treatment by which rapidly extended surveys would give definite shape to the country by the survey of its principal

features, determine the nature of its resources, and provide facilities for the detailed surveys of parcels or localities as required.

The extent of country involved was so great that it was essential that a sound survey structure should be built up. The surveys while conforming to the requirements of speed, mobility, and economy must measure up to such an accuracy that no future resurveys would be necessary, and that positions established may be accepted within the recognized limit of error and be capable of simple adjustment. The elasticity in the operation of the system and the



SURVEYOR RECEIVING TIME SIGNALS

Radio is one of the newest of "survey instruments." The surveyor is fixing the geographic position of Brochet on Reindeer lake, comparing standard time received by radio with observed local time for longitude.

rigidity of the survey structure are two of the chief features of the control survey. The system may be rapidly extended to any locality on which interest is centred and will at once furnish an accurate map of the district on which the mining claims, lots, or other parcels of land are shown in their correct position.

The general policy is to build up a net work of lines of control surveys extending into the unsurveyed country to the north. This net work is permanently marked on the ground by monuments placed at readily accessible

points to which future surveys may be tied. This system permits the issue of increasingly complete maps of the country and promotes the knowledge of it and its resources.

By the control survey method the position of each monument is calculated from a known position which may be a monument of the Dominion lands survey

CONTROL SURVEYS IN NORTHWEST TERRITORIES

The work of the surveyor has not only changed the size and shape of the lakes but has moved the geographic position many miles as compared with the sketch maps of the early explorers.

system or a point established in latitude and longitude by astronomical observation. The permanent monuments are accepted as legal monuments established under the Dominion Lands Surveys Act.

For convenience and economy the control surveys follow the travelled water routes. The surveyor is thus enabled to collect information of value for navigation and these water features are in the most urgent need of mapping.

The practice has been maintained of issuing the map of a district within a few months of the completion of the ground survey.

During the season two parties were employed on control survey work in northern Saskatchewan and Manitoba. C. S. Macdonald, D.L.S., extended control through the Reindeer lake area to establish monuments and to permit of the plotting of the aerial photographic survey carried on by the Royal Canadian Air Force with R. D. Davidson, D.L.S., directing the lines of flight. From the aerial and control surveys the lake and bordering country have been completely mapped. The survey was also carried across the Swan river route to Wollaston lake, along the east side of this lake and down the Cochrane river its entire length to Reindeer lake.

The second party under the direction of B. H. Segré, D.L.S., commenced work at Compulsion bay on Wollaston lake at the point where the portage from Swan river ends. The control traverse was carried up the west shore of Wollaston lake and extended down Fond-du-lac river, across Hatchet and Black lakes to Fond-du-lac trading post on lake Athabaska.

The country traversed in the operations of these two parties lies almost entirely in the Laurentian plateau and is covered with a fair growth of small spruce, birch, and Banksian pine with scattered tamarack and poplar. The surface is rocky, till being found on the lower parts. In following the Fond-du-lac river a sandy area of morainic character 110 miles in width was crossed to the east of Black lake. Here the Banksian pine predominates. Fur-bearing animals, game, and fish are abundant and considerable water power may be developed on the Cochrane, Reindeer, and Fond-du-lac rivers, particularly the latter, which drops about 600 feet between Wollaston lake and lake Athabaska. There are numerous falls and rapids and the discharge was about 12,000 cubic feet per second in midsummer.

In the Northwest Territories, G. H. Blanchet, D.L.S., continued the survey of Great Slave lake, taking advantage of late spring conditions to carry a chain traverse across the lake on the ice to serve as a check on the survey of the lake, which includes between five and six thousand miles of shore line. The survey was then extended through the Lockhart river system which enters Great Slave lake at its eastern extremity and has its watershed in the great northern plains. These have been described as the "barren lands" but it was found that the name was entirely unjustified and that the country possesses resources in its great ranges, its wild life, and its mineral possibilities.

During the course of the survey an exploration was carried northwesterly to the source of Coppermine river at lac de Gras and a new water route was investigated by which Coppermine river may be reached, and through it the Arctic ocean. Trade with the eastern Arctic is becoming increasingly important.

The survey and exploration permitted the mapping of the height of land portion of the northern plains which includes the headwaters of those great rivers of the north, Coppermine, Backs, Thelon, and Lockhart. First-hand information was also obtained as to the character of the country.

In order to provide accurate control for the topographical mapping required in the eastern provinces, control surveys were made over the areas covered by the Sorel sheet in Quebec, latitudes 46° to 46° 15′ and longitudes 73° to 73° 30′, and the Windsor sheet, Nova Scotia, latitudes 45° to 45° 15′ and longitudes 64° to 64° 30′. The surveys for the Sorel sheet were carried out by one party under the direction of P. M. H. LeBlanc, D.L.S., and those for the Windsor sheet were made by a party under the direction of A. L. Cumming, D.L.S.

The importance of the objects served by such maps necessitates accuracy in all the details of map making, the first essential of which is an accurate control datum to which all the details shown on the maps may be referred. For this purpose chained circuits, connected to points established by the Geodetic Survey, Department of the Interior, were made over the roads in these areas, and the geographical positions of all points to be shown on the maps were thus accurately located. For the purpose of amplifying the control

detail the chained circuits were supplemented by short stadia lines between the chained circuits. Monuments were established at intervals of approximately five miles for the purpose of permanently marking on the ground positions which in the future may serve as reference points for provincial or federal purposes.

BELL BUOY—GREAT SLAVE LAKE
An aid to navigation set by the Topographical Survey to mark shoals off the mouth of Slave river.

LAND SURVEYS

In last year's report it was stated that landowners in the western provinces are becoming more interested in their holdings and that this finds expression in an increasing volume of correspondence on a variety of subjects relating to lands. During the year just closed there has been a notable increase in the volume of office work in connection with inquiries for information.

Owing to the increasing tourist traffic in the west the subdivision of Waterton Lake townsite as designed was completed, 191 lots being laid out and posted. Nugent townsite on vacant school lands along the Lacombe and Northwestern railway was subdivided, comprising 103 lots. Owing to settlement at railway stations situated on Dominion lands, subdivisions were designed and laid out at Holbein, Saskatchewan, where 89 lots were surveyed; at Mafeking, Manitoba, where 61 lots were laid out; and at Rackham, Manitoba, with 197 lots.

In the recreational area in eastern Manitoba administered by the Canadian National Parks Branch, Department of the Interior, a subdivision comprising 39 lots was designed and laid out at Brereton lake and another small subdivision comprising 16 lots was laid out at West Hawk lake.

Historic sites for the Canadian National Parks were laid out as follows: one at Yale, British Columbia; one at Frog Lake, Alberta; one near Prescott, Ontario; two in the Eastern townships of Quebec; and two in Nova Scotia.

To meet the demands of settlement in remote localities, settlement lots were laid out at Rae, Resolution, and Fort Smith, in the Northwest Territories;

at Bowden lake along the Hudson Bay railway; and another subdivision adjoining Pine River settlement along lake Winnipegosis. In connection with the survey of Indian reserves several small lots were laid out on Oxford and God's lakes, lying east of lake Winnipeg.

In response to requests from residents in the locality of lac la Biche, 400 quarter-sections were surveyed for settlement in five townships. This survey was confined to those lands that had been examined in a land classification survey and had been reported suitable for agricultural purposes; the area actually surveyed was less than half of the tract petitioned for, the balance being unsuitable for immediate settlement. A subdivision comprising 28 quarter-sections close to the town of Big River, Saskatchewan, was made, the survey having been requested by the Board of Trade of Big River and the land having been reported suitable for settlement by one of the surveyors.

Surveys required in connection with the administration of the dry bed of Waterhen lake in Saskatchewan were also made. This lake has recently been drained by the Reclamation Service of this Department.

Small miscellaneous surveys required by the Department in the administration of Dominion lands were made in thirty townships besides those already referred to.

F. D. Henderson, D.L.S., who was in charge of the Arctic expedition, was able to lay out lots for the Royal Canadian Mounted Police at Dundas Harbour on Devon island and at Rice strait on Ellesmere island, the land boundaries of the latter being the most northerly ever laid out and legally monumented by a surveyor.

Besides Mr. Henderson only two surveyors were wholly engaged on land surveys during the season: J. A. Calder, D.L.S., and C. M. Walker, D.L.S. Wm. Christie, D.L.S., was engaged for half of the season. Owing to the broadly scattered localities of the foregoing surveys it was found convenient to employ several surveyors engaged upon other surveys to complete miscellaneous land surveys required along the route necessitated by their other work.

T. S. Nash, D.L.S., who has charge of the Land Surveys division of the branch, spent a few weeks in the field. He surveyed 28 lots at Bowden settlement in township 68, range 8, west of the Principal meridian and made several smaller surveys. He also investigated the status of the resurvey of Prince Albert settlement and took up with the provincial officials the question of what further surveys would be required.

The survey of Quartz Mining claims by surveyors privately employed has continued without abatement in the same districts as before. These surveys are being made largely in the Rice lake district, in the Herb lake district, and in The Pas district, Manitoba; and in the Keno Hill district, Yukon territory. H. G. Dickson, D.L.S., under contract made a reference traverse from Steep creek to Mayo, Yukon territory, and erected suitable reference monuments at frequent intervals.

Instructions were prepared in detail for the survey of 183 mining claims and the returns of survey of 260 claims many of which were in duplicate or triplicate were examined for approval. The compilations of these surveys in each mineral district have been kept up to date.

During the year descriptions were prepared for the Federal electoral districts in British Columbia and a number of miscellaneous parcels comprising rights-of-way, foreshore rights, etc.

The western provinces are required by statute to submit plans of new roads across Dominion lands to the Surveyor General for acceptance, in order to acquire title thereto. Three hundred and forty-four plans showing five hundred and thirty-nine miles of road were received and examined.

Plans of railway rights-of-way are examined for approval by the Surveyor General before being used by the Department. Forty-five plans, comprising with the duplicate and triplicate copies 110 tracings, were dealt with during the year.

Eight plans showing irrigation schemes were received from the Reclamation Service and were examined to determine whether they were sufficient for departmental purposes.

Owing to the volume of investigation and computation connected with replies to correspondence the number of township plans prepared for the draftsmen was only 104 together with 32 plans of miscellaneous surveys. The draftsmen's copies of 252 plans were compared with the compiled plans and passed for approval and 170 printed plans were released for distribution. In connection with the foregoing work 7,066 recorded field notes and plans were obtained from the record office for consultation.

OXCART TRANSPORT ON DOMINION LAND SURVEYS

This means of transport on the Fitzgerald-Fort Smith portage at the north boundary of Alberta has been replaced by tractors and motor cars.

LEVELLING

During the year two special level parties were employed and in addition a leveller was attached to the party engaged on township subdivision surveys northwest of lac la Biche in Alberta. The level parties were engaged on original levelling along base, correction, and range lines in Saskatchewan and Alberta. One of them operating in the district south of the Cypress hills levelled the First correction line from the east boundary of range 13, west of the Third meridian, to the east boundary of range 17, west of the Fourth meridian. The other levelled along the Sixteenth base line between the Fourth and the Fifth meridians. In addition, both parties levelled along a considerable mileage of range lines in their districts.

The total new levelling accomplished amounted to 651 miles. The total of all classes of levelling in the western Canada net at the end of the fiscal year was 37,811 miles, this being the number of miles actually levelled on the

ground and does not include re-levelling where such was necessary. The various classes of work and the mileages are as follows:—

	Season 1924	Total
Precise levels	....	4,541
Secondary control levels	539	7,448
Township outline levels	....	1,859
Meridian and base line levels run during their survey	....	12,770
Subdivision levels	112	10,753
Other lines of levels	....	440
	651	37,811

In the office 34 level books containing over 2,200 pages of level notes were received from the field, examined, and checked.

Over 17,000 elevations included on 380 sheets and 35 township plans were supplied to the head office during the fiscal year. These elevations occur along 5,000 miles of levelled lines. Other organizations and individuals were also supplied with 1,300 elevations.

The manuscripts for two publications were prepared. The first deals with results of levelling along certain railway lines in Manitoba, Saskatchewan, and Alberta and records 4,140 miles of levelling, including 1,160 permanent bench marks and over 3,000 elevations of railroad stations, and road and stream crossings, all arranged in one list in continuous order by mileage along each line. The second manuscript deals with levelling along base lines, range lines, and township outlines in the southerly parts of Manitoba and Saskatchewan extending northerly from the international boundary to a little north of Winnipeg in the east and to Prince Albert and Lloydminster in the west. This is a record of bench marks only, the elevations of natural features being compiled in separate lists. The report covers 2,240 bench marks established along 6,800 miles of levelled lines.

All elevations in the two publications are referred to the same datum which is the result of a recent preliminary adjustment of all the precise levelling in the western provinces. The precise level adjustment gave the elevations of the junction points of the net, after which more than one hundred secondary circuits were adjusted and then the elevation was calculated for each individual bench mark along the secondary lines. The elevations of about half of the bench marks along the precise level lines had also to be adjusted. The result of all this work is the first co-ordinated framework of levelling to be extended over the areas between railway lines. A ready comparison with general levelling throughout the West has thus been afforded. The two manuscripts covering 11,000 miles of levelling contain information relating to 3,400 bench marks and the elevations of 3,020 other points. In this summary report it is impossible to give an adequate idea of the amount of work involved in the co-ordination of all these levels.

In addition to the work in western Canada outlined above, 228 miles of tertiary spirit levels were run in Nova Scotia and 240 miles in Quebec as control for topographical mapping.

INTERPROVINCIAL BOUNDARY SURVEYS

ALBERTA-BRITISH COLUMBIA BOUNDARY

During 1924 the survey was completed of the portion of the Alberta-British Columbia Boundary which it is intended to mark on the ground at present. The survey of this boundary has now been completed from its most southerly extremity at the international boundary or 49th parallel of latitude northerly to a point in township 97. Northerly from this latter point the delimitation of the boundary will probably not be required for some time to come.

This boundary follows the summit of the Rocky mountains from the 49th parallel to the most northerly intersection of the summit or watershed with the 120th meridian of longitude, thence northerly along the 120th meridian to the

ALBERTA-BRITISH COLUMBIA BOUNDARY

Stone cairn witnessing the position of monument 56-2 on the 120th meridian near the summit of Rocky mountains. Also triangulation flag.

60th parallel of latitude. The photo-topographical method of survey was applied by the Commission to the summit or watershed survey excepting the passes. These surveys have been carried out under the immediate supervision of Mr. A. O. Wheeler, B.C.L.S., D.L.S., F.R.G.S., the British Columbia Commissioner. The surveys which have been made of the 120th meridian and of the passes in the watershed, have been carried out under the immediate supervision of Mr. R. W. Cautley, A.L.S., D.L.S., the Alberta and Dominion Commissioner.

The surveys made during 1924 consisted in closing the two last remaining gaps in the watershed portion of the boundary, and in completing the most southerly portion of the 120th meridian. The survey of the watershed was produced northerly from township 55 to the intersection of the 120th meridian, and thence northerly along the mountainous portion of the meridian to a point in township 61. The control for the survey of the watershed northerly from Yellowhead pass was furnished by triangulation surveys carried out during 1923 and 1924 by the Geodetic Survey. The survey of the southerly portion of the 120th meridian from township 61 to the intersection of the watershed was effected by means of triangulation, and monuments were established along the line at conspicuous points. During the season a portion of Crowsnest pass, which had hitherto been unsurveyed was also completed. Surveys made during 1923 and 1924 indicate that the position of the boundary line northerly from Yellowhead pass to the 120th meridian is somewhat different from that shown on previously published maps.

MAGNETIC SURVEYS

During the year, as in the past, magnetic surveys were continued by all the survey parties. The necessary precise astronomical bearings are available from the land surveys, and the magnetic measurements, which occupy but a few minutes, were made whenever an opportunity occurred during the regular work.

Some 700 magnetic observations were thus obtained throughout the country, from the Atlantic to the Pacific and from the international boundary to far beyond the Arctic circle. The total number of observations now exceeds 20,000 and this work could not have been carried on by others without considerable expense.

Some of the more outstanding features of the work were the large number of declination observations obtained in new country around Great Slave, Artillery, Clinton-Colden, Aylmer, de Gras, MacKay, and Ptarmigan lakes in the Northwest Territories; around Oxford, God's, Reindeer, Wollaston, Hatchet, and Middle lakes, and Cochrane, Swan, and Fond-du-lac rivers in northern Manitoba and Saskatchewan; in Ontario, Quebec, New Brunswick, and Nova Scotia; and at Dundas Harbour and Ponds Inlet in the Arctic islands, these latter being obtained during the expedition of the C.G.S. "Arctic."

Three Dover Dip Circles were employed for determining the magnetic intensity and the magnetic inclination, which latter element has lately acquired additional practical importance because it is used with the newly-invented Earth Inductor Compass now being employed on airplanes, ships, etc. One of these Dover Dip Circles was very kindly loaned by the Director of the Dominion Observatory. Observations were obtained at Tathelei Narrows of Great Slave lake, Artillery lake, Ptarmigan lake, Thanakoie Narrows between Clinton-Colden and Aylmer lakes, and at Outram lake in the Northwest Territories; at Greenhill, Pugwash, Windsor, Joseph, and Halifax in Nova Scotia; and at Dundas Harbour and Ponds Inlet in the Arctic islands.

Many repeat observations were made at important points throughout the country for the purpose of keeping the old magnetic work up to date and preventing it from becoming obsolete; and for the purpose of supplying the Provincial authorities, surveyors, and others with information regarding the change in the pointing of the compass over long periods of time.

All instruments used on this work were standardized at the beginning and the end of the season at the Magnetic Observatory at Agincourt, Ontario, through the courtesy of Sir Frederic Stupart, Director of the Meteorological Service of Canada, and thus all results were reduced to International Magnetic Standard.

Several short articles describing the magnetic work were written for different purposes. A new illustrated magnetic report, Bulletin 52, "Magnetic Results in Western Canada," with four isomagnetic maps, was published. This report gives a brief explanation of how a most extensive magnetic survey is being carried out in new and difficult territory at practically no expense by combining it with the other surveys. It contains practically all the magnetic data of this survey from 1880, when it was commenced, to the end of 1922.

Magnetic maps were distributed to those who use the magnetic compass in their daily work, comprising surveyors, airmen, navigators, explorers, miners, prospectors, timber-cruisers, settlers, etc., as well as to the general public. Correspondence was carried on with many scientific and government authorities, commercial firms, and individuals. Much magnetic information was supplied, especially secular change data, in order that survey lines run many years ago by compass might be retraced and re-established.

The magnetic stations were plotted on sheets of the sectional map, and the other general office work of computing, reducing, and preparing returns for publication; compensating for diurnal inequality and secular variation; etc., was carried out as in the past.

Researches were made in the diurnal inequality and secular variation with the object of improving the work and handling it more expeditiously and economically. An extensive research was carried out on the accuracy of the instruments used on the magnetic survey, during which the accuracy of 100

different instruments was investigated. This research shows very clearly that, owing to the selection of very fine instruments and to the proper care exercised in their use and in keeping them in good repair and working order, the standard of accuracy of the work is very high, even though the operations are often carried out under great difficulties.

As the large amount of data shows, this organization has for years co-operated towards obtaining a complete knowledge of the magnetized state of the earth and its various confusing changes which are constantly occurring. This is not only very useful to all compass users but will undoubtedly aid very materially in working out problems of practical value associated with the question of terrestrial magnetism.

PHYSICAL TESTING LABORATORY

The former name "Surveys Laboratory" has been changed to "Physical Testing Laboratory." It was felt that as the laboratory does a considerable amount of work for other departments, the name should be altered to one giving a better idea of the class of work handled. "Physical Testing Laboratory" indicates at once the function of the laboratory, and has therefore been adopted as the official title.

Arrangements were made during the year for the laboratory to undertake all the repairs of instruments used by the various branches of the Department; and later, owing to requests from other departments, it was arranged that repairs could be made for them also. One very important advantage of the laboratory instrument shop is that the repair work is done under technical supervision. All instruments repaired are checked and tested in the laboratory before being sent out.

In June the Supervisor of the laboratory left for a holiday trip to Europe. Advantage was taken of this opportunity to verify two of the laboratory standard rules. Standard rules must be handled very carefully as shocks or other rough treatment are likely to cause changes in length which, though inappreciable for many practical purposes, become serious when the utmost refinement is sought. Whenever possible the standards are therefore transported by messenger rather than by express. As the standards in question had been sent to Canada by express after the original standardization, there was always some doubt as to whether their lengths had changed during transit.

The Supervisor took with him the two laboratory standard rules, two steel tapes which had been studied regularly for some years, some standard thermometers, and metre rule No. 12,091 belonging to the Geodetic Survey of Canada. He first visited the Bureau International des Poids et Mesures, Sèvres, near Paris. The Bureau, which has the custody of the international metric and other important international units is maintained by subscription from practically all the civilized countries of the world, the subscription being based on the populations of the different countries. In return the supporting countries can have measures standardized without charge. The Bureau is a sort of central authority in matters of standardization, owing to the international character of the governing body and the work handled. The Director, Mons. C. E. Guillaume, and the other officials were extremely courteous and apart from the importance of the standardization work, the visit to the Bureau was well worth while, due to the opportunity afforded for taking part in the actual work and studying the methods employed.

After leaving the Bureau the Supervisor proceeded to the National Physical Laboratory, at Teddington, near London. This laboratory is a very large institution, handling a considerable range of physical and engineering work, both research and routine tests, which, owing to the size of the laboratory, is sub-

divided extensively so that specialization is carried on to a high degree. The field covered by the National Physical Laboratory includes work similar to practically all of that undertaken in our own laboratory, so that much valuable information was obtained in the course of conversation with the officials during the visit.

At Teddington the three standard rules and the two tapes were verified and the thermometers standardized. The Director of the Laboratory, Sir J. E. Petavel, and the other officials were very kind in rendering every assistance and supplying information.

Several firms manufacturing surveying and optical instruments, thermometers, etc., were visited, where further useful information was acquired. A visit to one London firm was of special interest as a precise barograph, being built for the Geodetic Survey of Canada to specifications drawn up by the officials of the Physical Testing Laboratory, was inspected in course of construction.

Surveying Instrument Section.—In addition to the usual amount of routine work an extended test was conducted to determine the amount of shrinkage after development of the photographic films used on aerial surveys. Two films were developed last October, and measurements have been made since from time to time between lines marked on the films. It was found that a gradual change in dimensions took place, which, though apparently slowing up, is still proceeding.

Meteorological Section.—The nickel and 42 per cent nickel steel standard rules were compared at Sévres with the International Bureau platinum-iridium prototype metre No. 26. This rule is a copy of the international metre, and was made at the same time. By reason of periodical comparisons with the metre its length is accurately known.

The observations were made in the Brunner comparator in which the international metre was intercompared with the different national prototypes before these were distributed to the subscribing states in 1890. By courtesy of the Director the representative of the Physical Testing Laboratory was allowed to conduct a set of comparisons in addition to the set made by the International Bureau observer. A closed series of comparisons was made by each observer; that is, calling the three rules A, B, and C, comparisons were made in turn between A and B, A and C, and B and C. Each pair was observed in eight relative positions. A total of 176 micrometer settings and 64 thermometer readings was made for each pair of rules by each observer.

The final results, as given in the official certificates by the International Bureau, were:—

	Length of Rules at 0°C.	
Observer	No. 306 (Ni)	No. 224 (42% Ni)
R.H.F. (P.T. Labortaory)	$1^m+17.46$ microns	$1^m+8.46$ microns
L.M. (Int. Bureau)	$1^m+17.60$ microns	$1^m+8.63$ microns
Mean..	$1^m+17.53$ microns	$1^m+8.54$ microns

The lengths for these rules as determined by the International Bureau in 1921, when the standard was the same (platinum-iridium rule No. 26), were:—

	Length of Rules at 0°C.	
Observer	No. 306 (Ni)	No. 224 (42% Ni)
L.M.	$1^m+16.6$ microns	$1^m+9.7$ microns

These results showed that the nickel rule No. 306 had lengthened by approximately one micron (i.e. 1 part in 1,000,000) and rule 224 had shortened by a slightly greater amount.

The rules were later compared at the National Physical Laboratory with the metre intervals on the N.P.L. nickel metre standards Nos. 16 and 184, the latter bearing two metre intervals and making in effect a closed series of five rules in the observations. Both the N.P.L. rules had been carefully verified at

Sévres a few weeks before these observations. In computing the final result No. 184 was taken as standard as (it was understood) No. 16 appeared to have suffered a change in length.

The lengths found by the National Physical Laboratory for the Canadian rules were:—

Length of Rules at 0°C	
No. 306 (Ni)	No. 224 (42% Ni)
$1^m+17.2$ microns	$1^m+8.0$ microns

It should be pointed out that, as the N.P.L. observations necessitate the intervention of an intermediate standard, whereas the International Bureau observations were made directly with a copy of the international metre, the latter observations are therefore entitled to the greater weight.

By courtesy of the Director of the National Physical Laboratory, the laboratory undertook the work of placing new graduations on the two rules Nos. 224 and 306, at one yard apart. This operation, which required rather skilful manipulation, was performed satisfactorily. A subsequent verification against rules which had themselves been compared with the imperial yard showed the lines to have been placed correctly to within one-thousandth of an inch at the standard temperature. Thus the Physical Testing Laboratory now has two standard yards, the values of which are known in terms of the imperial yard.

As soon as the preliminary operations have been completed, these rules will be compared with the Canadian legal standard yard, which has not been verified against the Imperial yard since 1874.

The two 24-metre steel tapes, ruled with exceptionally fine graduations, were verified on the N.P.L. tape bench against N.P.L. standard tapes. The lengths obtained for the tapes agree with the lengths given on the Physical Testing Laboratory base at Ottawa (when corrected for the latest value of the nickel and 42 per cent nickel rules) to within 1 part in 1,000,000, which is the limit of accuracy to be expected in comparisons of this nature.

Thus the opportunity was taken of checking the operations of obtaining the length of a tape from the initial point—the metre rule standardization—to the final bench test at the Physical Testing Laboratory.

Thermometers.—A new set of standards has been ordered for the thermometry section. It had been felt for some time that the present standards were not as precise as was desirable in view of the growing importance of this section. The new standards, covering the range 0° to 100° C., and graduated throughout to one-fiftieth of a degree, are now being standardized at the National Physical Laboratory.

The year has been remarkable for the increase in the number of clinical thermometers tested. In all 2,943 of these instruments were submitted; 2,823 were successful and 113 or 3.8 per cent failed to meet the tolerance. The remaining seven were received in a defective condition or broken in the test. The number of clinical thermometers tested during the past four years is as follows:—

Year	Clinical thermometers submitted
1921-22	172
1922-23	334
1923-24	1,016
1924-25	2,943

Beside clinical thermometers, 143 chemical and other thermometers were tested.

Aneroids.—As a result of the work done in previous years in improving the aneroid barometers belonging to this Survey, the aneroids are now in much

better condition and do not require so much attention when received back after a season in the field. It is felt, however, that still further improvements can be made by altering the design of the instruments. In this connection two well-known makers have expressed a desire to submit improved instruments, meeting specifications which have been drawn up by the laboratory. It is hoped that by this means an aneroid, superior to any at present obtainable, will shortly be available.

A precision barograph, made in London, England, to specifications prepared by the laboratory, was received at the close of the year. The specifications were prepared at the instance of the Geodetic Survey of Canada, which desired to employ a barograph as a base barometer in barometric levelling. No instrument then on the market was sufficiently precise for this work.

The new barograph, which differs radically in design from the usual type, is well thought out and carefully made. Up to the end of the year preliminary tests only have been made, but the following errors are guaranteed by the makers as having been measured under test:—

Friction error	barely detected
Creep (drift)	barely detected
Temperature error for a change of 40°C. in the temperature of the instrument	0.01 inch of mercury
Maximum calibration error	0.03 inch of mercury

It may be of interest to state that the record of the instrument shows short period variations in the atmospheric pressure which cannot be detected with the ordinary pattern instruments, and under certain weather conditions the pen can be seen to move up and down the chart within periods of a few seconds.

In addition to the usual amount of routine testing of aneroid barometers this section tested a special aneroid submitted on approval by a well-known firm, and the barograph submitted by the same firm. Three aneroids of a new type were tested for the Geological Survey. In these aneroids, at each reading a setting has to be made by turning a disc which operates a micrometer screw. The instruments are more precise than aneroids of the more usual pattern, but from experiments made at the laboratory it is established that a direct reading aneroid of robust construction can be made to give equally good results. An instrument of this latter type is at present considered more suitable for field work on Canadian surveys.

Watches.—Forty-one watches were submitted to the Class "C" test and twenty-three, intended for use in astronomical observations in the field, were submitted to a special test to determine the daily variation in rate over an extended period.

Instrument Repair Shop.—The instrument shop was kept fully occupied throughout the year. As mentioned previously the shop now conducts repairs for any branch of the public service. The most notable feature in this connection was the concluding of an arrangement with the Royal Canadian Air Force to carry out repairs to aeronautic instruments. The instruments dealt with during the year include, theodolites, levels, binoculars, altimeters, aneroids, barographs, alidades, electric soil testers, radio sets for surveying purposes, range-finders, microscopes, thermographs, compasses, drafting machines, surveying and ordinary cameras, etc.

MECHANICAL DIVISION

The work of this division includes the drafting, photographing, lithographing, and printing which are necessary in the different stages of making maps, and also includes the making of relief maps. These different processes are closely related and largely interdependent and are therefore grouped in one division.

The Topographical Survey has a complete map production organization from the field work and aerial photography to the printing presses and the work is all carried out under one roof with a maximum of speed and economy. The processes used are in accord with the most modern practices of the large map making establishment of the Ordnance Survey of Southampton, England, and of the large private plants at London and Edinburgh.

The following is a summary of the work done:—

(1) Jobs which were drafted, photographed, and lithographed—

Name	Number	Copies
Sectional maps	14	12,500
Land classification township plans	113	16,360
Official township plans	123	12,300
Maps for other branches and departments	24	37,048
Miscellaneous jobs	167	108,644
Totals	441	186,852

(2) Other work done in the drafting room—

	Number
General drafting and miscellaneous jobs	813
Photo prints mounted	6,516
Land classification plans, hand coloured	497
Jobs printed from type	500

(3) Details of work by photo-mechanical plant, including the work under item (1)—

(*a*) Process work—	
Wet plate negatives	2,560
Photo-lithographic plates	374
Half-tones and line cuts	388
Vandyke prints and blue-prints	3,725
(*b*) Photographic work—	
Contact prints	7,626
Enlargements	2,587
Plates developed	2,720
Aerial grids prepared	800

The following is a list of some of the more important maps printed:—

Name	Copies	Colours
Centre sheet of map of Alberta	1,000	4
Map of Rocky Mountains Park, Alta	2,900	4
Swift Current sheet No. 68 (revised) of the Sectional Map of Canada	2,000	8
Lethbridge sheet No. 15 (revised) of the Sectional Map of Canada	2,000	8
Wainwright sheet No. 266 (revised) of the Sectional Map of Canada	2,000	8
Minago sheet No. 372 of the Sectional Map of Canada	400	5
Map of Montreal district for relief model	50	5
Map of Toronto district for relief model	50	5
Exploratory map—Thunder river to McPherson, N.W.T.	800	2
Exploratory map—Mackenzie delta and bay, N.W.T.	800	2
Map of The Pas mineral area in Manitoba and Saskatchewan	800	3
Map of eastern end of Great Slave lake, N.W.T.	800	2
Exploratory map—Vermilion to Little Rapids, Alta.	800	2
Plan of McPherson settlement, N.W.T.	100	1
Plan of Aklavik settlement, N.W.T.	100	1
Land classification maps of five districts and soil maps of each	2,000 of each 20,000 in all	7
40 Township development plans	200 each	4
Map of St. Lawrence river showing Cartier's voyages	2,500	4

Name	Copies	Colours
Map showing Progress of Triangulation	1,500	3
Eight maps to illustrate route across Canada of the British Association for the Advancement of Science	1,050 of each	2
Ten maps of Aerial districts	1,000 of each	2
Soil map of Macleod district, Alta	3,000	7
Map of city of Kitchener, Ontario	500	3
Map of Essex Border district, Ont	500	3
Map of Waterpowers of Canada	18,000	5

Five sets of Astronomical Field Tables, totalling 2,500 copies were also printed.

Relief Maps.—Complete relief maps were made of the areas covered by the Dufferin and the Red Deer one inch to three miles sectional sheets, and of the one inch to one mile topographic maps of Jasper Park and of the districts surrounding Montreal, Toronto, Coaticook, and Sherbrooke. Exhibits of relief maps were prepared for the Toronto meeting of the British Association for the Advancement of Science, for the Canadian National Exhibition, Toronto, and for the Central Canada Exhibition, Ottawa.

REGISTRATION, RECORDS, AND DISTRIBUTION

The work of this division consists, in general, of registering and recording the field notes, plans, and maps received from surveyors and from other sources; furnishing copies of field notes and traverse plots as required; dealing with technical correspondence relating to the surveyors' field notes; storing and distributing the official plans of townships, townsites, settlements, etc.; distributing the various maps and publications issued by the branch, and other related work.

The following survey returns were received for examination from surveyors in the field, railway companies, and provincial governments, and were entered in the various registers, plotted on the index maps, etc.: 411 books of field notes, 1,418 plans, 439 progress sketches of field work, and 5,966 miscellaneous returns consisting of notes of magnetic surveys, reports, etc.

On the completion of the examination, the field books and original plans are placed on record. The signed copy of each official plan issued by the branch is also recorded. During the year 1,422 new plans and 412 new books were thus placed on record, the totals now being 33,725 plans and 19,077 books of field notes.

There was the usual public demand for maps, plans, reports, and technical pamphlets. During the twelve months there were distributed 31,292 maps, 12,747 plans, and 1,400 reports. Many copies were supplied to officials without charge, but during the year the mailing lists were carefully gone over and action taken to reduce the number of free copies in future. Maps are supplied to the public at a nominal charge sufficient to prevent wastage. The revised sheets of the Sectional Map of Canada have been most in demand, after which come the land classification and soil maps. As an example, however, of the demand for other special maps it might be stated that in July last 800 copies of the map of The Pas mineral area were printed and that the stock of this map is now exhausted.

During the year the Alberta-British Columbia Boundary Report and Atlas, Part II, was issued. Part III is in course of preparation.

The work of dealing with requests for technical information relating to surveys and survey records was carried on as usual. These requests were received from various branches of the federal and provincial governments, surveyors and engineers, law firms, and from the general public, and relate to survey monuments, conflicting boundaries, etc. This involves not only searching the surveyors' field notes and files but in many cases supplying copies of the notes and preparing survey sketches. When required for the law courts the copies of the

notes and plans are officially certified. Seven hundred and thirty-seven such requests were dealt with.

For many years Dominion land surveyors have been able to take azimuth observations on the pole star in daylight, even at noon when the sky was exceptionally clear. They did not have to use the old method of observing on the star at elongation. Their success has been due to the printed tables prepared by the Topographical Survey showing the azimuth of the pole star and its altitude at each ten minutes throughout the 24 hours of the day. The azimuth also varies with the latitude of the point of observation and these variations were referred to the townships of the Dominion land system of survey. The associations of provincial land surveyors have been desirous of using the time saving method of observing employed on Dominion land surveys. Consequently, in recent years these tables have also been computed by the Topographical Survey and printed on a latitude basis. They are in use from coast to coast. The demand for these tables is increasing greatly every year.

GEOGRAPHIC BOARD

The Secretary of the Geographic Board, whose function is to decide all questions concerning geographic names in the Dominion which arise in the departments of the public service, is an officer of the Department of the Interior. During the year the 18th report, containing all decisions regarding the spelling of place-names in the Dominion since the inauguration of the Board in 1897 to March 31, 1924, was published; the rulings of the Board since that date have been published in the *Canada Gazette* and in pamphlet form.

During the year Colonel W. P. Anderson, representing the Department of Marine and Fisheries, was elected chairman in place of the late Dr. Deville, and Mr. J. D. Craig, Director General of Surveys, joined the Board as a Department of the Interior representative. Mr. W. Fleet Robertson, the British Columbia representative of the Board for 24 years, resigned on retirement from the provincial service and was succeeded by Mr. G. G. Aitken, Chief Geographer of the province, and Mr. L. C. Charlesworth, the Alberta representative, resigned in favour of Mr. J. A. Jaffary the provincial librarian, Edmonton.

BOARD OF EXAMINERS FOR DOMINION LAND SURVEYORS

The Board of Examiners for Dominion Land Surveyors held three meetings during the year.

The first was a special meeting lasting from Monday, April 28, 1924, to Wednesday, June 4, 1924, inclusive, during which examinations were held at Ottawa, Montreal, and Calgary.

The second was a special meeting held on Tuesday, November 4, 1924. At this meeting a resolution of condolence was passed in connection with the death of Dr. E. G. Deville, the late Chairman of the Board, which occurred on September 21, 1924. Certain subjects of examination which were in pressing need of revision, were taken up by the Board.

The third was the regular annual meeting called for by section 9 of the Dominion Lands Surveys Act. It began on Monday, February 10, 1925, and lasted until Thursday, March 12, 1925, inclusive. During this meeting examinations were held at Ottawa, Calgary, and Halifax.

The total number of candidates who presented themselves at the examinations was fifty-four. Of these thirty-seven tried the preliminary examination, four tried the final examination, and thirteen tried the levellers' examination.

Twenty-two candidates were successful at the preliminary examination, as follows:—

Bizier, Lionel, Montreal, P.Q.
Boisvert, Charles, Montreal, P.Q.
Byers, John Wilfred, Halifax, N.S.
Caty, Jean Jacques, Montreal, P.Q.
D'Aragon, Paul, Montreal, P.Q.
Forget, Jean Maurice, Montreal, P.Q.
Genest, J. Adrien, Montreal, P.Q.
Gingras, Guillaume, Montreal, P.Q.
Hanson, Ralph Ellis, Halifax, N.S.
Hatton, Gerald Percy, Calgary, Alta.
James, Frank Horace, Ottawa, Ont.
Lalonde, Jean Paul, Montreal, P.Q.
Laurence, Emile, Montreal, P.Q.
MacLaren, Lorn Albert, Montreal, P.Q.
Mathieu, Albert, Montreal, P.Q.
Proulx, Georges, Montreal, P.Q.
Ranger, Gaston, Montreal, P.Q.
Rinfret, Guy Raoul, Montreal, P.Q.
Roberge, Antonio, Montreal, P.Q.
Ross, Redvers Robert, Halifax, N.S.
Valiquet, Charles, Halifax, N.S.
Webber, George, Calgary, Alta.

Three candidates were successful at the final examination, namely:—

Fry, Eric Stanley, Ottawa, Ont.
Russell, Benjamin, Calgary, Alta.
Palsen, Gudlangur, Calgary, Alta.

Nine candidates were successful at the levellers' examination, namely:—

Blair, Robert Thompson, Calgary, Alta.
Cooper, Douglas LeBaron, Halifax, N.S.
Davison, Henry Francis, Halifax, N.S.
Driver, Harcourt Arnold, Ottawa, Ont.
Harris, Arthur Clifford, Halifax, N.S.
Jenkins, William Stockton, Ottawa, Ont.
Morrison, Gilbert Rutter, Halifax, N.S.
Poole, John Maurice, Halifax, N.S.
Williams, Harry Percy, Ottawa, Ont.

The time of the Board during the meetings was largely taken up with the reading and valuation of the candidates' answer papers. Complete sets of question papers to be used at the following examination were also prepared. In addition to this the evidence submitted by candidates at the final examination in proof of their eligibility therefor had to be examined. This evidence consisted of certificates of Provincial Land Surveyors and of affidavits of service under articles of apprenticeship. The finished plans and notes as well as the plans and notes executed under field conditions, furnished by the candidates at the final examination had also to be examined and evaluated.

Several of the text books recommended by the Board in the past for the preparation of different examination subjects, having become obsolete or out of print, it became necessary for the Board to recommend new substitute text books. The selection of suitable text books entails a great deal of work and occupied the Board to a considerable extent during the last two meetings.

Three commissions were issued to candidates who had passed the final examination and had furnished oaths of office and allegiance and bonds for the sum of one thousand dollars, as required by Section 25 of the Dominion Lands Surveys Act.

Eight certificates of preliminary examination were issued to successful candidates who had complied with the requirements of the law.

Nine certificates as levellers were issued to candidates who had successfully passed the examination.

One surveyor sent in his standard measure to be tested.

The Chairman of the Board of Examiners for Dominion Land Surveyors, Dr. E. G. Deville, died on September 21, 1924. Dr. Deville passed the final Dominion Land Surveyors' examination and the examination in higher surveying (Dominion topographical examination) on November 12, 1877, and was granted a commission in both examinations. On November 15, 1878, Dr. Deville's book "Examples in Geodetic and Astronomical Calculations," was submitted to the Board. A resolution of appreciation was passed by the Board expressing their admiration for this masterful compilation and one dozen copies were forthwith purchased. In 1879, he became a member of the Board.

During the year Mr. F. H. Peters was appointed Chairman of the Board.

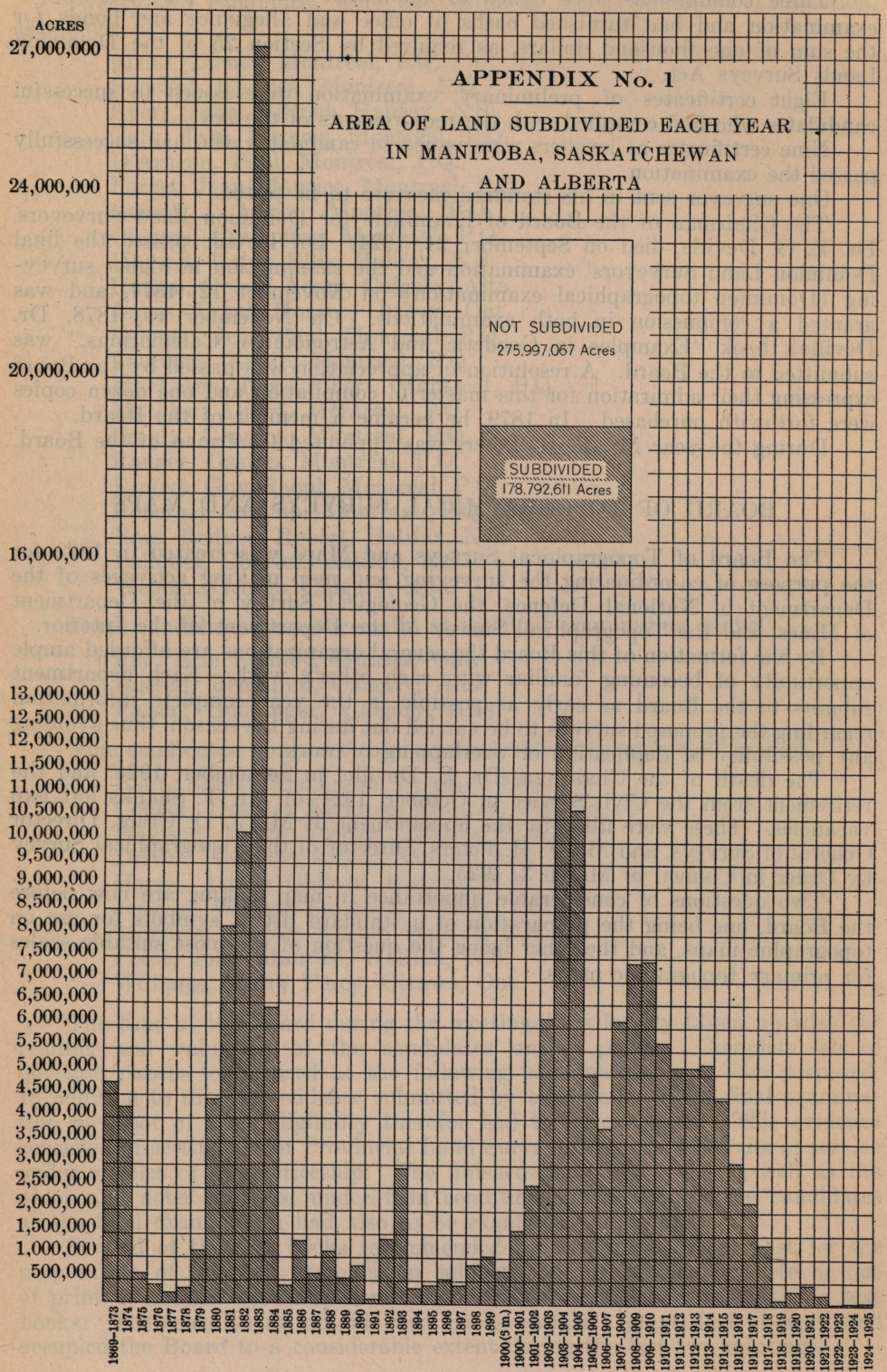
BOARD OF TOPOGRAPHICAL SURVEYS AND MAPS

The Board of Topographical Surveys and Maps was created in 1922 for the purpose of co-ordinating the surveying and map making activities of the Department of National Defence, the Geological Survey of the Department of Mines, and the Topographical Survey of the Department of the Interior.

By the formation of this Board the several organizations are afforded ample opportunity of becoming familiar with each other's work. Each department submits to the Board as early as possible in the year complete information regarding the proposed surveys to be carried out during the season, thus avoiding any possibility of duplication or overlapping of work.

The death of the Chairman, Dr. E. Deville, in September, 1924, and the retirement from the Civil Service in October, 1924, of Mr. T. Shanks left two vacancies. These were filled by the appointment of Mr. J. D. Craig, Director General of Surveys, and Mr. F. H. Peters, Director of the Topographical Survey by Order in Council of March 3, 1925.

Two questions of considerable importance in map making are now before the Board, one being the preparation of a standard list of symbols for use on topographic maps, and the other being the question of the most suitable scales for primary topographic maps.


APPENDIX No. 1
AREA OF LAND SUBDIVIDED EACH YEAR IN MANITOBA, SASKATCHEWAN AND ALBERTA
NOT SUBDIVIDED
275,997,067 Acres
SUBDIVIDED
178,792,611 Acres
ACRES
27,000,000
24,000,000
20,000,000
16,000,000
13,000,000
12,500,000
12,000,000
11,500,000
11,000,000
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1869–1873
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1901–1902
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1910–1911
1911–1912
1912–1913
1913–1914
1914–1915
1915–1916
1916–1917
1917–1918
1918–1919
1919–1920
1920–1921
1921–1922
1922–1923
1923–1924
1924–1925

APPENDIX No. 2

SCHEDULE OF SURVEYORS EMPLOYED AND WORK EXECUTED BY THEM:—

Berry, E. W.—

Secondary levelling along the north boundary of townships 2, ranges 13 to 30; east outline of range 17, townships 3 to 9; east outline of range 21, townships 3 to 7; east outline of range 25, townships 3 to 5; all west of the Third meridian; and along the north boundary of townships 2, ranges 1 to 16; east outline of range 5, townships 3 and 4; east outline of range 13, townships 3 to 8; all west of the Fourth meridian—335 miles of new levelling and in addition 27 miles of connections to former lines of levels.

Blanchet, G. H.—

Investigations of islands, bars, and channels of portion of Peace river; chain traverse across Great Slave lake on ice to effect ties between control surveys on south and north shores; completion of survey of shore line of Great Slave lake; control survey from east end of Great Slave lake over Pike's portage and through Artillery, Ptarmigan, Clinton-Colden, Aylmer, and Outram lakes and connecting waterways to lake MacKay; exploratory survey of lake MacKay and lac de Gras to Coppermine river; settlement surveys at Fort Smith, Resolution, and Rae; establishing aids to navigation on Great Slave lake.

Bridgland, M. P.—

Control surveys for and topographical mapping of a part of the Rocky Mountains forest reserve at the headwaters of North Saskatchewan river in Alberta.

Calder, J. A.—

Subdivision of a townsite at Holbein in township 49-2-3; subdivision of settlement lots in township 35-19-W. Pr.; subdivision of portions of townships 56 and 57, range 8, west of the Third meridian; stadia traverse surveys in townships 54 to 56, range 5, townships 50, 55, and 56, range 6, townships 53 to 56, range 7, townships 56 and 57, range 8, and township 40, range 12, all west of the Third meridian; investigation and report on lake in township 49-7-3; retracement survey in township 42-28-2.

Cautley, R. W.—

Survey of portions of the interprovincial boundary between Alberta and British Columbia comprising the uncompleted portion of Crowsnest pass, the 120th meridian southerly from township 61 to the summit of the Rocky mountains, and Robson and Miette passes.

Christie, W.—

Examination and classification of lands for general settlement in township 52, range 14, townships 51 and 52, ranges 15 to 20, and township 50, range 20, west of the Fifth meridian; subdivision of portions of townships 71 and 72, ranges 16 and 17, and township 70, range 17, west of the Fourth meridian.

Cowper, G. C.—

Topographical mapping for the revision of Yorkton sheet, No. 170, of the Sectional Map of Canada, comprising townships 25 to 32, ranges 1 to 15, inclusive, west of the Second meridian.

Cumming, A. L.—

Control survey for topographical mapping of the Windsor sheet, Nova Scotia, which covers the area within latitudes 45° and 45° 15′ north, and longitudes 64° and 64° 30′ west of Greenwich.

Dickson, H. G.—

Reference traverse from Steep creek traverse to Mayo in the Yukon territory about 30 miles (performed under contract, Mr. Dickson not being a member of the staff).

Fawcett, S. D.—

Investigation and classification of lands for general settlement in townships 55 to 60 ranges 20 to 27, west of the Third meridian.

Fletcher, W. A.—

Topographical mapping for the revision of Sullivan Lake sheet, No. 216, of the Sectional Map of Canada, comprising townships 33 to 40, ranges 1 to 14, inclusive, west of the Fourth meridian.

Hardouin, J.—

Topographical mapping for the revision of Weyburn sheet, No. 20, of the Sectional Map of Canada, comprising townships 1 to 8, ranges 1 to 15, inclusive, west of the Second meridian.

Henderson, F. D.—

Survey of group lots at Dundas Harbour in North Devon island and at Rice strait in Ellesmere island.

Knight, R. H.—

Investigation and classification of lands for general settlement in townships 49 to 56, ranges 1 to 6, and townships 54 to 56, ranges 7 to 14, west of the Fourth meridian; topographical mapping for the completion of the revision of Vermilion sheet, No. 316, of the Sectional Map of Canada in the above townships; survey of historic site at Frog lake, Alberta.

Lawrence, C. A. R.—

Survey of group lots at narrows of God's lake and at Oxford lake, Manitoba.

LeBlanc, P. M. H.—

Control survey for topographical mapping of the Sorel sheet, Quebec, which covers the area within latitudes 46° and 46° 15′ north, and longitudes 73° and 73° 30′ west of Greenwich.

Macdonald, C. S.—

Control survey of Reindeer lake, Cochrane river, and east side of Wollaston lake, in northern Manitoba and Saskatchewan.

Morency, G. E.—

Survey of Fort Crevier historic site about 20 miles east of Sorel, Quebec, performed while with P. M. H. LeBlanc.

McCloskey, M. D.—

Investigation and classification of lands in townships 44 and 45, ranges 3 to 8, townships 44 to 46, ranges 9 to 11, and township 43, range 10, west of the Second meridian, within the Pasquia and Porcupine forest reserves.

Nash, T. S.—

Subdivision of 28 lots at Bowden settlement in township 68-8-W. Pr; miscellaneous stadia and subdivision surveys in township 12-6-4, township 47-23-4, and township 46-25-4; investigation of survey of Prince Albert settlement.

Norrish, W. H.—

Spirit and stadia level control surveys, west half of Edmonton sheet, No. 315, of the Sectional Map of Canada; topographical survey (plane table) for an inch to one mile map of the Edmonton district covering the area between latitudes 53° 27′ and 53° 50′ north, and longitudes 113° 10′ and 113° 40′ west of Greenwich; investigation and report on a water area in section 19, township 53-25-4; laying out the boundaries of a radio telegraph station at Edmonton, Alberta.

Palmer, P. E.—

Topographical survey (plane table) of a part of the New Glasgow sheet, which sheet is included within latitudes 45° 30′ and 45° 45′ north, and longitudes 62° 30′ and 63° 00′ west of Greenwich; surveys of the Fort Lawrence and Grand Pré historical sites in Nova Scotia.

Pierce, J. W.—

Land classification in the portion of the Riding Mountain forest reserve east of range 20, and in township 29, range 27, in the Duck Mountain forest reserve, all west of the Principal meridian; restoration and stadia surveys in township 17, range 7, east of the Principal meridian; control surveys of waterways in the portion of the Cross Lake sheet, No. 74, of the Sectional Map of Canada, lying in the province of Ontario; survey of the Fort Levis historical site between Prescott and Cornwall in the province of Ontario.

Read, H. E.—

Secondary levelling along the north boundary of townships 60 between the Fourth and Fifth meridians; east outline of range 5, townships 60 to 62; east outline of range 9, townships 58 to 60; east outline of range 17, townships 59 and 60; all west of the Fourth meridian—203 miles of new levelling and in addition 16 miles of connections to former lines of levels.

Rinfret, C.—

Completion of the topographical survey (plane table) in co-operation with the Department of National Defence, of the Warwick sheet, which sheet is included within latitudes 45° 45′ and 46° 00′ north, and longitudes 71° 30′ and 72° 00′ west of Greenwich; survey of the Lacolle Mill historic site at Lacolle, Quebec.

Segré, B. H.—

Control survey in northern Saskatchewan of west and north shores of Wollaston lake and of Fond-du-lac river westerly through Hatchet and Black lakes and lake Athabaska as far as Fond-du-lac trading post.

Taggart, C. H.—

Control surveys for and topographical mapping in the Kamloops district, British Columbia.

Walker, C. M.—

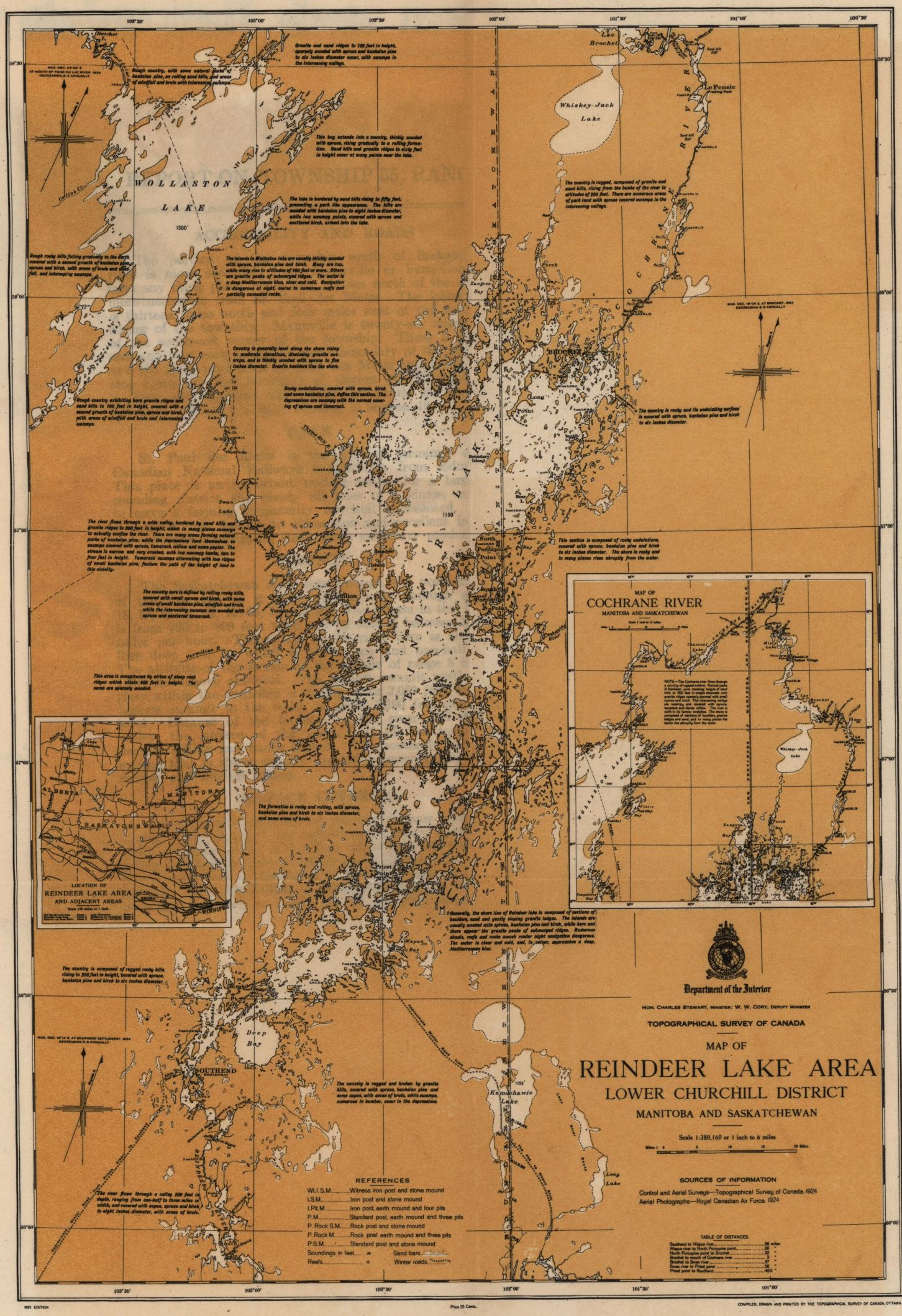
Subdivision of townsites at Rackham in township 18-19-W. Pr., Mafeking in township 43-26-W. Pr., and Nugent in township 44-3-5; subdivision of summer resort lots at Brereton lake in townships 10 and 11-15-E. Pr. and at West Hawk lake in township 9-17-E. Pr.; subdivision of an addition to Waterton lakes townsite in township 1-30-4; subdivision of the reclaimed bed of Waterhen lake in township 45, range 21, and townships 45 and 45A, range 22, west of the Second meridian; stadia traverse surveys in townships 41 and 42-13-2, 40-16-2, and 40-17-2; miscellaneous retracement in townships 41-9-2, 36-14-2, 38-19-2, and 41-21-2.

Waugh, B. W.—

Topographical survey (plane table) of a part of the Sussex sheet, which sheet is included within latitudes 45° 30′ and 45° 45′ north, and longitudes 65° 30′ to 66° 00′ west of Greenwich.

Wheeler, A. O.—

Photo-topographical surveys of portions of the interprovincial boundary between Alberta and British Columbia comprising part of the summit of the Rocky mountains between Yellowhead pass and the 120th meridian and along the 120th meridian southerly from township 61 to the summit of the Rocky mountains.


Granite and sand ridges to 150 feet in height, sparsely wooded with spruce and banksian pine to six inches diameter occur, with swamps in the intervening valleys.
Rough country, with some natural stand of banksian pine, on rolling sand hills, and areas of windfall and brule with intervening muskeg.
This bay extends into a country, thickly wooded with spruce, rising gradually to a rolling formation. Sand hills and granite ridges to sixty feet in height occur at many points near the lake.
WOLLASTON LAKE
1300'
The lake is bordered by sand hills rising to fifty feet, presenting a park like appearance. The hills are wooded with banksian pine to eight inches diameter, while low swampy points, covered with spruce and scattered birch, extend into the lake.
Rough rocky hills falling gradually to the north, covered with a second growth of banksian pine, spruce and birch, with areas of brule and windfall, and intervening swamps.
The islands in Wollaston lake are usually thickly wooded with spruce, banksian pine and birch. Many are low, while many rise to altitudes of 100 feet or more. Others are granite peaks of submerged ridges. The water is a deep Mediterranean blue, clear and cold. Navigation is dangerous at night, owing to numerous reefs and partially concealed rocks.
Country is generally level along the shore rising to moderate elevations, disclosing granite outcrops, and is thickly wooded with spruce to five inches diameter. Granite boulders line the shore.
Rocky undulations, covered with spruce, birch and some banksian pine, define this section. The depressions are swampy with the normal covering of spruce and tamarack.
Rough country exhibiting bare granite ridges and sand hills to 100 feet in height, covered with a second growth of banksian pine, spruce and birch, with areas of windfall and brule and intervening swamps.
The river flows through a wide valley, bordered by sand hills and granite ridges to 200 feet in height, which in many places converge to actually confine the river. There are many areas forming natural parks of banksian pine, while the depressions land themselves to swamps covered with spruce, tamarack, willow and some poplar. The stream is narrow and very crooked, with low swampy banks, two to four feet in height. Tamarack swamps alternating with low ridges of small banksian pine, feature the path of the height of land in this vicinity.
The country here is defined by rolling rocky hills, covered with small spruce and birch, with some areas of small banksian pine, windfall and brule, while the intervening swamps are wooded with spruce and scattered tamarack.
This area is conspicuous by virtue of steep rock ridges which attain 400 feet in height. The same are sparsely wooded.
The formation is rocky and rolling, with spruce, banksian pine and birch to six inches diameter, and some areas of brule.
Generally, the shore line of Reindeer lake is composed of sections of boulders, sand and gently sloping granite ledges. The islands are usually wooded with spruce, banksian pine and birch, while here and there appear the granite peaks of submerged ridges. Numerous shoals, reefs and rocks awash render night navigation dangerous. The water is clear and cold, and, in colour, approaches a deep Mediterranean blue.
The country is composed of rugged rocky hills rising to 200 feet in height, covered with spruce, banksian pine and birch to six inches diameter.
The country is rugged and broken by granite hills, covered with spruce, banksian pine and some aspen, with areas of brule, while swamps, numerous in number, occur in the depressions.
The river flows through a valley 300 feet in depth, ranging from one-half to three miles in width, and covered with aspen, spruce and birch to eight inches diameter, with areas of brule.
The country is rugged, composed of granite and sand hills, rising from the banks of the river to altitudes of 200 feet. There are numerous areas of park land with spruce covered swamps in the intervening valleys.
The country is rocky and its undulating surface is covered with spruce, banksian pine and birch to six inches diameter.
This section is composed of rocky undulations, covered with spruce, banksian pine and birch to six inches diameter. The shore is rocky and in many places rises abruptly from the water.
Whiskey-Jack Lake
Le Pensic
Trading Post
Lac Brochet
Brochet
Zanzes Bay
Long Point
Boundary Island
North Porcupine Point
South Porcupine Point
Steep Rock Pt.
Priest Point
Wapus Bay
Deep Bay
SOUTHEND
Settlement
Kamuchawie Lake
Long Lake
Swan Lake
Mid Lake
Vermilion R.
Thorn Hill Creek
Wollaston Lake
Reindeer Lake
Cochrane River
Reindeer River
Wollaston Lake Portage
MAG. DEC. 24°03' E. AT MOUTH OF POND DU LAC RIVER, 1924 DECREASING 8.3 ANNUALLY
MAG. DEC. 19°04' E. AT BROCHET, 1924 DECREASING 9.3 ANNUALLY
MAG. DEC. 19°14' E. AT SOUTHEND SETTLEMENT, 1924 DECREASING 9.0 ANNUALLY
LOCATION OF REINDEER LAKE AREA AND ADJACENT AREAS
Scale 155 miles to 1 inch.
ALBERTA
SASKATCHEWAN
MANITOBA
WINNIPEG
MAP OF COCHRANE RIVER
MANITOBA AND SASKATCHEWAN
Scale 1 inch to 12 miles
NOTE.—The Cochrane river flows through a country of rugged outline. Natural parks of banksian pine covering ranges of sand hills to 100 feet in height alternate with granite ridges sparsely covered with small spruce and birch. The intervening valleys are swampy, and covered with spruce, tamarack and dense willow. The river is swift in its narrow stretches. The shore is composed of sections of boulders, granite ledges and sand, and in many places the banks rise abruptly from the water.
Department of the Interior
HON. CHARLES STEWART, MINISTER; W. W. CORY, DEPUTY MINISTER
TOPOGRAPHICAL SURVEY OF CANADA
MAP OF
REINDEER LAKE AREA
LOWER CHURCHILL DISTRICT
MANITOBA AND SASKATCHEWAN
Scale 1:380,160 or 1 inch to 6 miles
Miles 1 0 5 10 15 20 Miles
SOURCES OF INFORMATION
Control and Aerial Surveys—Topographical Survey of Canada. 1924
Aerial Photographs—Royal Canadian Air Force. 1924
TABLE OF DISTANCES
Southend to Wapus river ..... 30 miles
Wapus river to North Porcupine point ..... 60 "
North Porcupine point to Brochet ..... 32 "
Brochet to mouth of Cochrane river ..... 3 "
Brochet to Swan river ..... 57 "
Swan river to Priest point ..... 56 "
Priest point to Southend ..... 405 "
REFERENCES
Wt.I.S.M. ..... Witness iron post and stone mound
I.S.M. ..... Iron post and stone mound
I.Pit.M. ..... Iron post, earth mound and four pits
P.M. ..... Standard post, earth mound and three pits
P. Rock S.M. ..... Rock post and stone mound
P. Rock M. ..... Rock post earth mound and three pits
P.S.M. ..... Standard post and stone mound
Soundings in feet ..... 23 Sand bars
Reefs ..... × Winter roads
1925 EDITION
Price 25 Cents.
COMPILED, DRAWN AND PRINTED BY THE TOPOGRAPHICAL SURVEY OF CANADA, OTTAWA

This reduced copy of the Reindeer Lake map is intended to show the detailed information obtained from aerial surveys.

ALBERTA

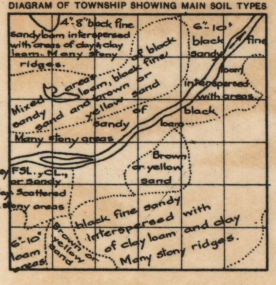
Map of Township 55, Range 8, West of the Fourth Meridian

Prepared by the Topographical Survey of Canada, Department of the Interior, Ottawa

SCALE 60 CHAINS TO AN INCH

LAKE ELIZA 1939
LAKE 1920
LAKE 1921
LAKE 2002
NORTH SASKATCHEWAN RIVER
FORT ISLAND
Dead end green poplar 3"-12"
Poplar and willow 4 to 6 ft high & scatt poplar 2"-8" Some stumps & windfall.
Widely scattered bluffs of 2"-4" poplar and brush to 6 ft high.
Bluffs of 4"-8" poplar and brush to 5 ft. high.
Sandhills Nearly open Some scattered light brush and poplar.
Hillside scattered poplar to 6"
Broken hillside scattered poplar to 6"
Poplar 6"-10"
Poplar 3"-8"
Numerous bluffs of 5"-8" poplar. Stony
Dead & green poplar to 5" MC
RS to north
LC. Dead and green poplar 6" to 10" Some stones & gravel ridges.
Fair grass
Poplar and willow 4 to 6 ft high and scattered poplar 2"
Scattered bluffs of 4"-8" poplar
Abandoned Broken hillside Scattered bluffs of poplar to 6"
Poplar brush to 6 ft high. Scattered poplar 6"
Nearly open Scattered dead & green poplar to 6" & scrub to 6 ft high.
Numerous bluffs of 3"-6" poplar
Bluffs of 3"-8" poplar
Sandhills
Light scrub open
Light brush & dead & green poplar
Dense poplar 8 ft. high.
Light poplar brush. Nearly open
Poplar brush 4 to 6 ft high. Scattered poplar to 5"
Light scattered poplar 6" and brush to 6 ft high
Poplar brush to 6 ft high and scattered dead and green poplar
Sandy Poplar to 6"
Good pasture of bluffs of 6" poplar
Poplar brush 4-8 ft. Scattered poplar to 4"
Poplar 2"-8"
Light poplar brush 4 to 10 ft high. Scattered poplar to 4"
Widely scattered clumps of poplar and willow to 5 ft high. Some stones.
Widely scattered poplar and willow brush 3 to 5 ft high and some scattered poplar 2" to 4"
Nearly open Scattered poplar 2"-5"
Poplar 2"-5"
Poplar 4"-10" and willow 12 ft high
Poplar 4"-8"
Poplar & spruce 3"-12"
Bluffs of 3"-8" poplar
Scattered poplar to 6"
Gentle slope to North
Gentle slope to Southeast
Gentle slope to West
Gentle slope to South
Gentle slope to Northwest
Gentle slope to Southwest
Slough
Creek
Swamp
Cemetery
SLAWA

DIAGRAM OF TOWNSHIP SHOWING MAIN SOIL TYPES


4"-8" black fine sandy loam interspersed with areas of clay loam. Many stony ridges.
6"-10" black fine sandy loam interspersed with areas of clay loam. Many stony ridges.
Mixed sandy soil and yellow sand
Many stony areas
Brown or yellow sandy soil
Scattered stony areas
6"-10" loam areas
Many stony ridges.

ABBREVIATIONS

Level	L.
Nearly Level	NL.
Undulating	U.
Gently Rolling	GR.
Rolling	R.
Heavily Rolling	HR.
Hilly	H.
Heavily Rolling to Hilly, etc	HR-H.
Slope or Sloping	S.
Lowland liable to flooding	LLF.
Cultivation	C.
Abandoned	Ab.
Scattered	Scatt.
Poplar	Pop.
Willow	Will.

LEGEND

Cultivated lands	C
Open or nearly open lands	
Light clearing	LC
Medium clearing	MC
Heavy clearing	HC
Hay meadows	
Hay marshes	
Swamps, marshes, muskegs	
Lakes, ponds, sloughs	
Streams	
Non-perennial streams	
Elevations (in feet above mean sea level)	1963
Post offices	•

Roads:

Main through roads	
Secondary roads	
Local roads, in good condition	
Local roads, in poor condition	
Pack trails	
Bridges	
Ferries	F
Buildings	▪
Churches	♁
Schools	♁

NOTE: Topography has been compiled from information obtained in the field on land classification surveys supplemented by the field notes of the subdivision surveys.

Lands investigated by R.H. Knight, Dominion Land Surveyor

August 1924

Sample of Township Development Plan, Land Classification Surveys

WESTERN CANADA
SHOWING MONUMENTED SURVEYS
BY
THE TOPOGRAPHICAL SURVEY OF CANADA

Scale 1 inch to 200 miles

LEGEND

Subdivided Areas.....

Governing and control surveys in areas not subdivided.....

VICTORIA ISLAND

YUKON

NORTHWEST TERRITORS

BRITISH COLUMBIA

ALBERTA

SASKATCHEWAN

MANITOBA

ONTARIO

HUDSON BAY

PACIFIC OCEAN

UNITED STATES

Mackenzie Bay
Richardson I.
Porcupine R.
McPherson
Peel R.
Yukon R.
Dawson
Stewart R.
Pelly
Selkirk
Lewes River
McMillan R.
White R.
Klhane L.
Teslin L.
Liard R.
Nahanni R.
Wrigley
Mackenzie River
Gravel R.
Norman
Good Hope
Great Bear L.
L. Mackay
Lac la Marte
Simpson
Providence
Great Slave Lake
Resolution
Fitzgerald
Fort Smith
Fort Nelson R.
Fort Nelson
Fort Simpson
Fort Wrigley
Fort Liard
Fort Halkett
Fort Hamilton
Fort Graham
Fort Ware
Fort Mcleod
Fort St. James
Fort George
Fort Macleod
Fort Saskatchewan
Fort Edmonton
Fort Vermilion
Fort McMurray
Fort Chipewyan
Fort Resolution
Fort Rae
Fort Providence
Fort Norman
Fort Good Hope
Fort Simpson
Fort Wrigley
Fort Liard
Fort Halkett
Fort Hamilton
Fort Graham
Fort Ware
Fort Mcleod
Fort St. James
Fort George
Fort Macleod
Fort Saskatchewan
Fort Edmonton
Fort Vermilion
Fort McMurray
Fort Chipewyan
Fort Resolution
Fort Rae
Fort Providence
Fort Norman
Fort Good Hope
Amundsen Gulf
Prince Albert Sound
Dolphin & Union Str.
Coronation Gulf
Bathurst Inlet
Queen Maud Gulf
Victoria Str.
King William I.
Boothia Pena.
Gulf of Boothia
Lind I.
Simpson Str.
Dease Str.
Chantrey Inlet
Franklin Bay
Liverpool B.
Brown R.
Baring Land
Anderson R.
Kendall
Clarey
Kruzenstern
Copermine R.
L. Macdougall
L. Garry
L. Pelly
Back R.
Thelon River
Dubawnt L.
Dubawnt R.
Kasan
Kasba L.
Nueltin L.
Yathkyed L.
Chesterfield Inlet
Rankin Inlet
Marble I.
Eskimo
Churchill
Tatnam
Cape Henrietta Maria
Jones
Sleepers
Belcher Is.
Ottawa Is.
Portland Promontory
Mansel I.
Fisher Str.
Lyon Str.
Coats I.
Smith
Mosquito B.
Payne L.
Minto
James Bay
Akimiski I.
Fort Albany
Fort Severn
Severn River
Winisk R.
Ekwan R.
Attawapiskat
Albany River
Hudson Str.
Port Nelson
Nelson River
Hayes R.
Cross L.
Island L.
Moose L.
Poplar R.
Berens R.
The Narrows
L. Winnipeg
Lake of the Woods
Rainy L.
Rainy R.
Port Arthur
Fort William
L. Superior
L. Seul
L. St. Joseph
Superior
English R.
Winnipegosis
Dauphin
Swan R.
Red R.
Assiniboine R.
Souris R.
Qu'Appelle R.
Portage la Prairie
Brandon
Regina
Moose Jaw
Medicine Hat
Calgary
Edmonton
Battleford
Prince Albert
Saskatchewan R.
Red Deer R.
Bow R.
Milk R.
Missouri R.
Columbia R.
Kootenay R.
Kootenay L.
Okanagan L.
Shuswap L.
Arrow Lakes
Revelstoke
Kamloops
Nicola L.
Fraser R.
Fraser River
Vancouver
Vancouver I.
Victoria
Nanaimo
Seattle
Tacoma
Nootka I.
Queen Charlotte Sound
Hecate Strait
Dixon Entrance
Prince of Wales I.
Graham I.
Queen Charlotte Islands
Moresby I.
Princess Royal I.
Baranof I.
Chichagof I.
Cross Sd.
Stikine R.
Taku R.
Taku Inlet
Glacier B.
Juneau
Sitka
Yakutat B.
Mt. St. Elias
Mt. Logan
Mt. Brown
Mt. Hooker
Mt. Robson
Mt. Assiniboine
Mt. Sir Donald
Mt. Stephen
Mt. Temple
Mt. Lefroy
Mt. Victoria
Mt. Goodsir
Mt. Forbes
Mt. Columbia
Mt. Alberta
Mt. Edith
Mt. Cavell
Mt. Hunter
Mt. Brazeau
Mt. Robson
Mt. Assiniboine
Mt. Sir Donald
Mt. Stephen
Mt. Temple
Mt. Lefroy
Mt. Victoria
Mt. Goodsir
Mt. Forbes
Mt. Columbia
Mt. Alberta
Mt. Edith
Mt. Cavell
Mt. Hunter
Mt. Brazeau
Lake Michigan
Duluth
Milwaukee
Chicago
St. Paul
Minneapolis
Sioux City
Omaha
Kansas City
St. Louis
Memphis
New Orleans
Galveston
Houston
Dallas
Fort Worth
Oklahoma City
Tulsa
Wichita
Topeka
Kansas City
St. Joseph
Omaha
Lincoln
Grand Island
North Platte
Cheyenne
Denver
Colorado Springs
Pueblo
Albuquerque
Santa Fe
El Paso
Phoenix
Tucson
Los Angeles
San Diego
San Francisco
Sacramento
Stockton
Fresno
Bakersfield
Reno
Carson City
Salt Lake City
Ogden
Provo
Boise
Pocatello
Idaho Falls
Twin Falls
Portland
Salem
Eugene
Medford
Klamath Falls
Seattle
Tacoma
Spokane
Walla Walla
Pasco
Yakima
Wenatchee
Ellensburg
Olympia
Aberdeen
Hoquiam
Raymond
South Bend
Astoria
Longview
Kelso
Vancouver
Portland
Salem
Eugene
Medford
Klamath Falls
Reno
Carson City
Salt Lake City
Ogden
Provo
Boise
Pocatello
Idaho Falls
Twin Falls
Spokane
Walla Walla
Pasco
Yakima
Wenatchee
Ellensburg
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Astoria
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Kelso